8. Scheduling Services

The FOS Planning and Scheduling (P&S) subsystem provides a common set of capabilities for scheduling the spacecraft, instruments, and ground resources associated with EOS. The Scheduling subsystem has three primary objectives: producing a conflict-free schedule of activities for the EOS spacecraft; establishing communication contacts; and generating the ATC load and ground schedule. The system also supports definition of constraints in a data base to be used to identify any conflicts that may arise among activities scheduled by different instrument teams. The Scheduling subsystem provides tools to ingest supporting data from the Flight Dynamics Division (FDD), to coordinate the communications contact with the Network Control Center (NCC), and to distribute P&S data with the Instrument Support Toolkits (ISTs).

NOTE

To use the Scheduling system tools you will need to log in to the system using proper user id and password with appropriate user role that allows the use of these tools. Please refer to section 5 Userstation Operations for more information on logging in to the system.

A high level Scheduling operations scenario includes the following:

1. **FOT and IST teams define activities, Baseline Activity Profiles (BAPs), and constraints to be used for scheduling and conflict checking.** These are defined in the beginning of the mission, and then updated as needed.
2. **Planning Aids are received from the FDD, validated, processed, and ingested into the system on a daily basis.** The Planning Aids include data such as: orbital events, visibility data, and ephemeris data.
3. **Users at the EOC and ISTs schedule BAPs and individual activities needed to accomplish science and spacecraft objectives for the day.**
4. **Based on science and spacecraft telemetry requirements, communication contacts are scheduled to communicate with the spacecraft through TDRS or ground stations, to command the spacecraft and receive SSR and real-time data.**
5. **Once all necessary activities are scheduled and contacts are satisfactorily established, loads are generated to be uplinked to the spacecraft.** Scheduling tools allow the FOT to generate the Detailed activity schedule (DAS) which in turn is used to generate the ATC loads, and ground schedule.

Following generation of the ATC loads, the next step is to use the ground schedule to generate the ground script for use in the real-time operations during a pass. Please refer to section 9, Real time services for further information.

The following sections are ordered in the same manner in which Scheduling functions are recommended to take place for a particular mission day. Keep in mind that certain tools/capabilities

are only available to the FOT at the EOC and care is taken to point out where tools/capabilities are available. See Figure 8.1.1-2 for a graphical overview of Planning and Scheduling tools.

8.1 Scheduling Services Overview

8.2 Defining Activities

8.3 Defining and Understanding Baseline Activity Profiles

8.4 Using Constraints

8.5 Timeline tool: Working with Plans

8.6 Scheduling

8.7 ASTER Filter

8.8 Generating Loads

8.9 Validating Database

8.10 Planning and Scheduling Tips

8.1 Scheduling Services Overview

This section provides a typical scenario regarding the exchange of data with external subsystems such as FDD and NCC, and what operations activity you would be performing in a given role in time (FOT, IST team member, ASTER team member), relative to the operations day. It also describes briefly the Configuration Control Process that you must follow during operations, the use of tools that must be running in the background for supporting successful operation of other tools, and how you define activities, BAPs, and constraints before you use them for scheduling. Figure 8.1-1 illustrates the flow of scheduling products through the system.

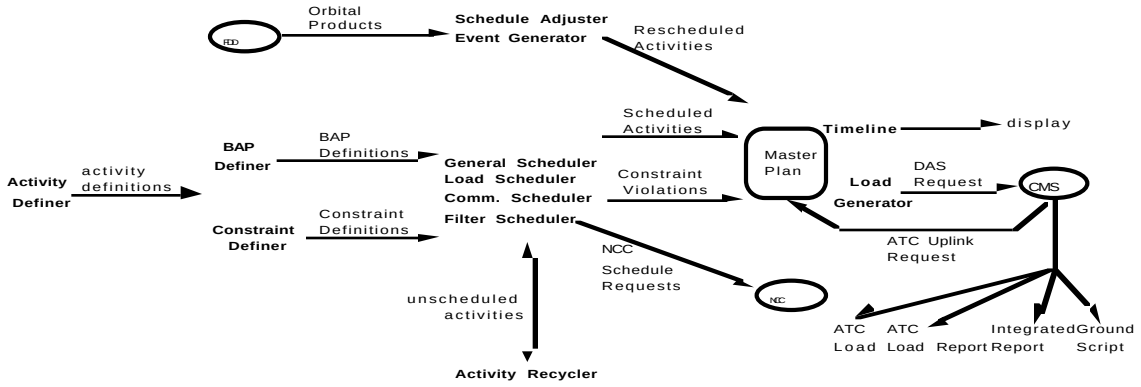


Figure 8.1-1. Flow of Scheduling Products Through the System

8.1.1 Scenario For Creating a Schedule for a Typical Day

Figure 8.1.1-1 shows the different phases of scheduling that need to occur in order to create a mission schedule for a given target day. As represented in the diagram, many PAS tasks take place simultaneously without impacting the work of different users. For example, the FOT can establish a communication contact schedule with the NCC while deviation scheduling is occurring at the EOC and ISTs. If conflicts arise at any stage of schedule development, users are notified of the violation through their software, allowing them to resolve the discrepancy. Because scheduling can begin six weeks before the target day, the goal is to resolve any conflicts before ATC load generation occurs. A mission schedule will not be converted into an ATC load if hard constraints exist in the system for the given time period. This is a safety policy enforced by the software.

For a given target day, the following scheduling tasks will occur, creating of an ATC load and ground script.

NOTE

All time estimates are approximations; they are only intended to show the natural flow of scheduling tasks at the EOC and ISTs.

1. **Long-Term Planning (TD > 7 weeks)**

   The initial phase of Planning and Scheduling occurs more than six weeks before the target day. During this time period, the planner can create or modify the scheduling items that are under configuration control. These include activity definitions, constraint definitions and baseline activity profile (BAP) definitions. The planner validates these items in a test environment, avoiding any impacts to the operational system. Once testing is complete, the definitions are moved from the test environment into the operational area following the configuration control procedures, making them available for use in the mission plans.

   FDD predicted orbit events will typically span seven weeks into the future; therefore, long-term planning (i.e. greater than seven weeks from target day) can only occur for activities that do not require orbit events. Examples include forecast spacecraft maneuvers and instrument maintenance activities. If the planner wishes to schedule activities relative to orbit events, he/she must wait until the FDD data is received and ingested into the database.

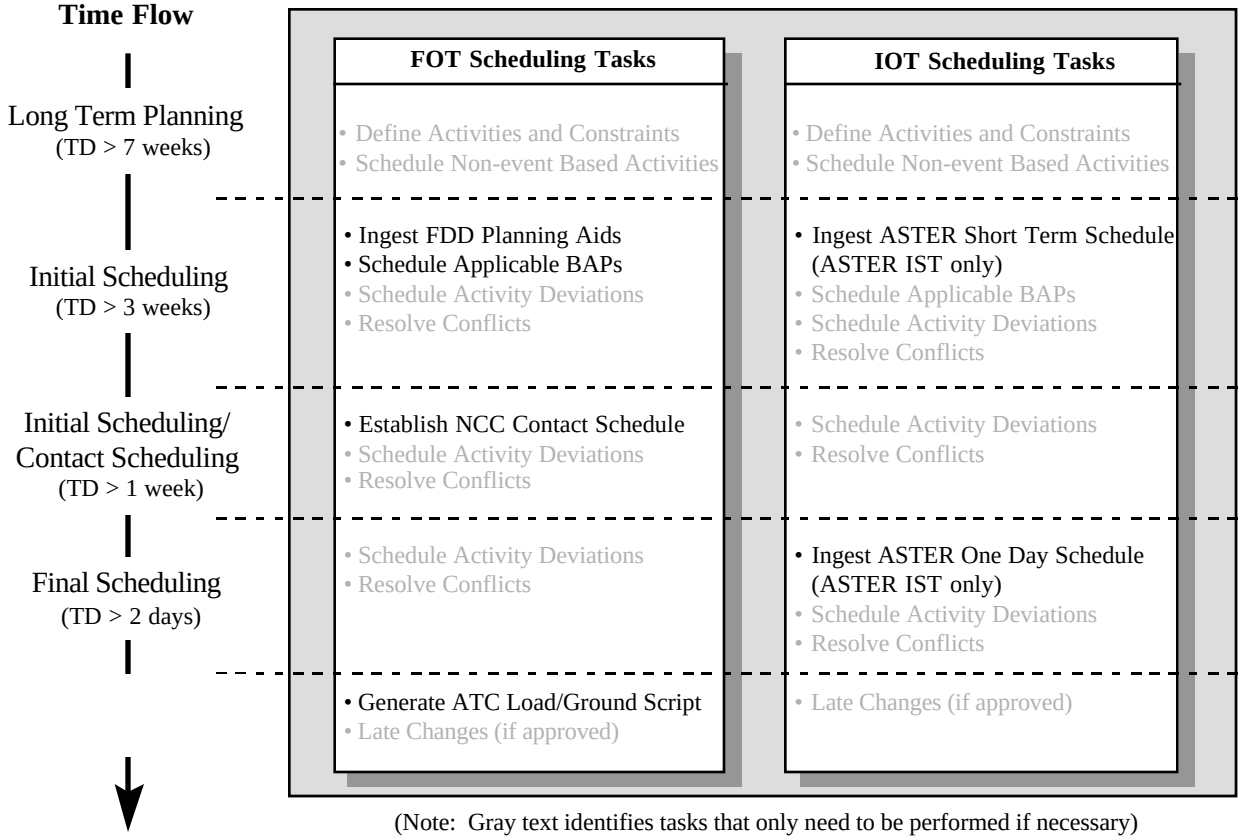
2. **Initial Scheduling (TD > 3 weeks)**

   The next phase of scheduling involves creation of an initial schedule for all the instruments and spacecraft subsystems. This initial schedule will be based upon the BAPs that establish the normal operations for each instrument and subsystem. In addition, deviations to the BAPs may be scheduled, incorporating activities that are not of a periodic nature. This initial schedule does not need to be constraint-free -- its primary purpose will be to establish the contact schedules that are sent to the NCC.

   Approximately seven weeks before the target day, FDD planning aids will be made available to the planners, allowing them to perform event-based scheduling. Most BAPs use activities that are scheduled relative to orbit events. For example, the CERES instrument can operate in a bi-axial scan configuration where the instrument continually switches from a normal scan mode to a short scan mode in order to avoid looking at the sun. Each of these CERES mode transitions

are triggered by activities that occur relative to orbit events. With the FDD planning aids, all BAPs can be scheduled, either automatically by the software or manually by the planner.

Once the instrument and subsystem BAPs are scheduled, the planner may wish to add activity deviations. The planner can add, modify and delete scheduled activities on any resource that they have permission to modify. Some instruments and subsystems will require more activity deviations than others, depending on the complexity of their operations.



(Note: Gray text identifies tasks that only need to be performed if necessary)

Figure 8.1.1-1. Scenario for Creating Mission Schedule for a Typical Day

The ASTER AGS uses their own scheduling system for establishing an instrument activity list based on the submittal of Data Acquisition Requests (DARs). Once their initial activity list is established, ASTER submits a Short-Term Schedule for incorporation into the AM-1 mission schedule. The PAS software automatically ingests this activity list and updates the mission plan. In addition, the ASTER AGS is notified of any constraints that occur during plan integration.

3. **Initial Scheduling With Contact Scheduling (TD > 1 week)**

With an integrated mission schedule now in place, the FOT can establish the NCC communication contacts. The FOT used the Scheduling software to automatically determine the placement of contact activities based upon an optimization algorithm. This scheduling algorithm uses at the SSR data volume profiles, TDRSS return service, uplink activity

requirements (TDRSS forward service) and AM-1 visibility to the TDRSS spacecraft to determine the contacts.

Approximately three weeks before the target week, the FOT submits a seven-day communications contact schedule to the NCC. Some requests may be rejected by the NCC due to spacecraft prioritization and availability of resources. The EOC will be notified of rejected contacts, allowing the FOT to submit modified communication requests. Electronic negotiations between the NCC and EOC is an iterative process that continues until approximately one week before the target week when the NCC sends a final contact schedule.

While negotiations are taking place between the EOC and the NCC, deviation scheduling can still occur for the instruments and subsystems. However, activities that require uplink opportunities or large data volume playback may not get adequate TDRSS contacts since the electronic negotiations with the NCC are ongoing. Planners should try scheduling these contact-dependent deviations before NCC negotiations begin.

4. **Final Scheduling (TD > 2 days)**

With the contact schedule established, the focus of planning and scheduling shifts to fine-tuning the activities for the target day. Planners should resolve any remaining constraint violations associated with their instrument or subsystem. In addition, schedule modifications can still be performed as long as their resource needs (e.g. data volume requirements) stay within the limits established in the contact schedule.

The ASTER AGS will send their updated activity list for the target day in the form of a One Day Schedule. The Scheduling software automatically ingests ASTER's activity list, updating the mission plan to reflect their changes. The Scheduling software also sends a copy of the activity list included in the DAS to ASTER AGS.

5. **Load Generation (Target Day > 6 hours)**

All schedule updates should be completed at approximately 2 days before the target day. This includes the resolution of constraint violations that affect instrument or subsystem operations. With the completed conflict-free schedule, the FOT can generate the corresponding ATC load and ground script. Once load generation occurs, the scheduled activities on the target day become frozen. Planners can still make late changes; however, they must contact the FOT so they can "unfreeze" the mission plan, allowing schedule changes to take place. Late changes to the target day should only be made for contingency situations (e.g. instrument health and safety) since any late change that occurs after the plan is frozen will require the FOT to re-generate the ATC load and ground script.

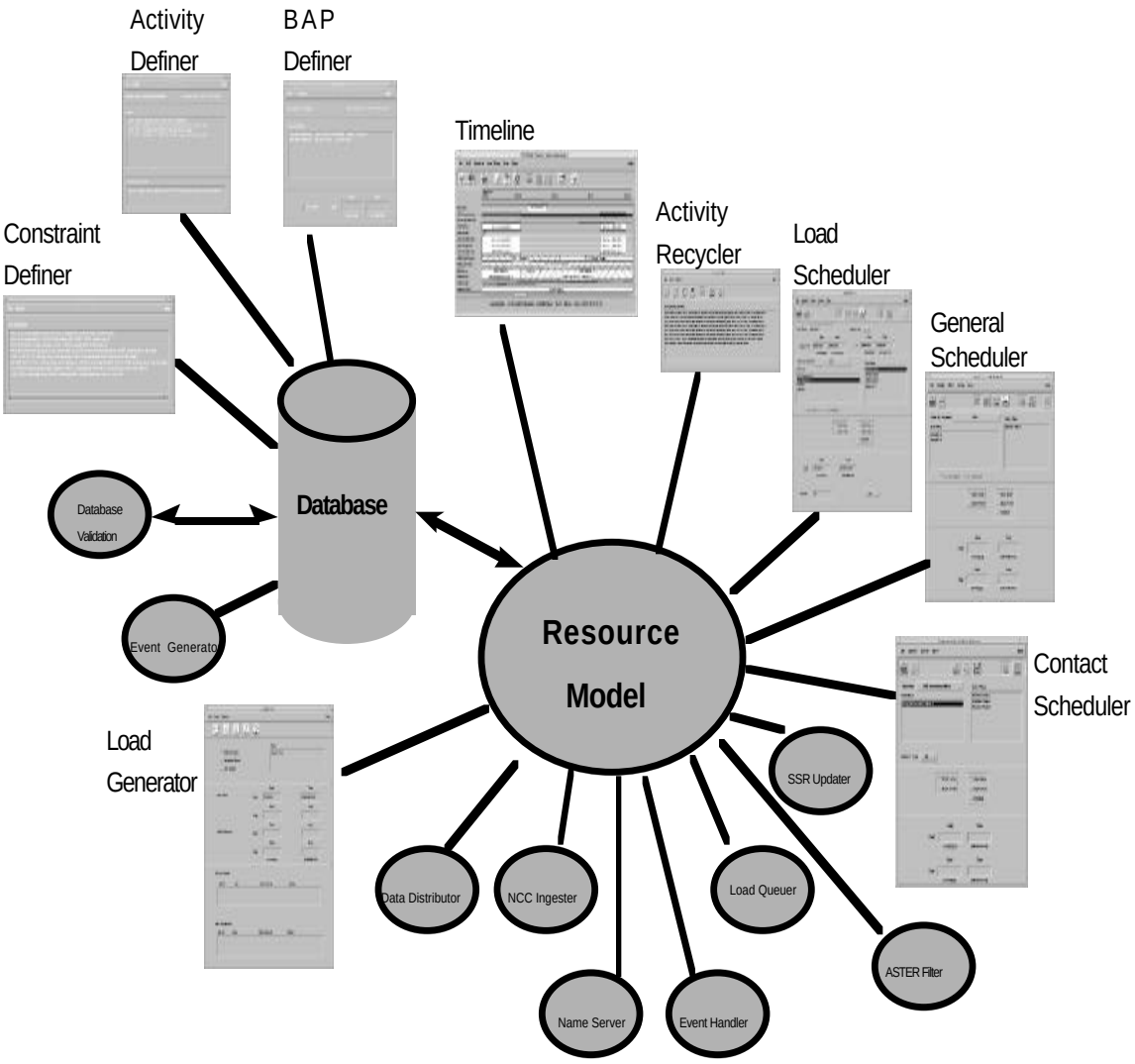


Figure 8.1.1-2. Overview of Planning and Scheduling Tools

8.1.2 Configuration Control of Activities and Constraints

Since the activities and constraints include spacecraft command sequences and parameters that can directly affect spacecraft health and ground operations, their definition needs to be controlled through a Configuration Control process.

The P&S system tools are used in two separate environments: TEST environment, and Operational environment. The activity Definer, BAP Definer, and Constraint Definer tools are used in the TEST environment to define, modify and test the activities, BAPs, and constraints. The scheduling tools are used in the Operational environment to schedule the activities and BAPs. After testing and ensuring that activities, BAPs, and constraints defined by the FOT are ready to be used for operations, these are moved to the operational environment, following procedures established by the Configuration Control Board. These procedures are likely to be reviewed and updated. You should contact the XXXXX person for the current procedures.

You need to be an "Authorized user" to define new activities, BAPs, and constraints, or modify existing ones. All userids have certain roles associated with them and a certain list of tasks that they can perform. This is to allow users to perform certain functions, but not others; you must be aware of the role you have when you define activities, BAPs, and constraints, and/or when you schedule activities or BAPs.

8.1.3 Background Support Processes

This paragraph explains background processes supporting Planning and Scheduling tools. They have an important role in the Planning and Scheduling system; they help model the spacecraft and the instruments on-board, allow sharing of modeling data with processes running in distributed environment, process event messages generated by other P&S tools, receive data from external subsystems, and update models. This section will give you some understanding of our architecture and how our software operates. The core background scheduling processes will be automatically started along with the IST Toolkit on a userstation. The ASTER Filter also runs in background, but it is more appropriately classified as a scheduling tool and is therefore addressed separately in Section 8.9.

8.1.3.1 Name Server

A Name server allows P&S processes to find one another in heterogeneous networked systems. The planning and scheduling Name server's primary purpose is to supply process location information to a requesting process. It does not affect the modeling of the spacecraft, but it does allow the other processes to communicate with one another. During system startup a Name server is brought up and processes connect to the Name server to register themselves (i.e., give their addresses to the Name server) and disconnect when they terminate. As an example, process A needs to communicate with process B. Process A connects with the Name server, asks the Name server for process B's address. Once process A has process B's address, process A can connect to process B. The Name server uses a database table to store the addresses of registered client processes. The Name Server is started from the Data server and Userstation startup scripts.

8.1.3.2 Resource Model

The Resource Model process is the heart of the planning and scheduling suite of software tools. The state and behavior of all scheduling components (referred to as resources) modeled for scheduling are contained within this process, including: representations of spacecraft, subsystems, instruments, and the activities those resources perform through time. Other tools within planning and scheduling modify the state of resources within the Resource Model by sending scheduling requests. In addition, the Resource Model checks for and identifies any resultant constraints when scheduling requests are received. Tools, such as the Timeline, receive and display constraints, and other activity scheduling information, contained within the Resource Model. Most Scheduling tools will not run without a Resource Model running first since they obtain, display, and modify data represented within the Resource Model. The Resource Model is started from the Data server and Userstation startup scripts.

8.1.3.3 Data Distributor

The Data Distributor provides the means for distributing scheduled activities when geographically diverse users operate distinct Planning and Scheduling systems. The Data Distributor processes comprise of a network connecting distinct Planning and Scheduling systems. Data Distributors are clients of resource models; they receive updates from resource models. When a resource model creates a significant change in state, its Data Distributor receives the information and passes it to all of the other Data Distributors. When the other Data Distributors receive the information, they pass it along to their resource models which in turn update their state. Data Distributors help keep all resource models updated and working in synchronization. The Data Distributor is started from the Data server and Userstation startup scripts.

8.1.3.4 Load Queuer

The Load Queuer provides background support to the load generator and acts as an interface with the CMS. It helps the load generator produce command-level constraint checks, and produces a detailed activity schedule that will be converted to an ATC load for uplink to the spacecraft, and a ground script that will be placed into a ground schedule. This process only runs on the Data server at the EOC and is started from the Data server startup script.

8.1.3.5 Solid State Recorder Updater

The Solid State Recorder (SSR) Updater receives at the end of each pass, “as flown” data, from the analysis subsystem, concerning the level of usage in the Solid State Recorder data buffers. Since real-time changes may have occurred during the contact, the data buffer levels represented in the resource model may be out of date. The SSR Updater modifies each buffer’s data level before the next pass, in order to provide the most accurate information concerning the on-board Solid State Recorder data buffers. The data is used to update states on each buffer in the resource model. The Timeline graphs the “as flown” data and the predicted usage levels of the Solid State Recorder buffer. The Solid State Recorder Updater also sends the contact times and the predicted data volume for each buffer to the analysis subsystem before the beginning of a pass. This process only runs at the EOC on the Data server.

8.1.3.6 NCC Ingester

The NCC Ingester is a background process that receives messages from the NCC regarding status of TDRS contacts. These messages tell the planning and scheduling system if the requested contacts were rejected, accepted, confirmed, or deleted. The ingester takes these messages and updates the states of the appropriate contact according to the NCC message. This process only runs at the EOC on the Data server.

8.1.3.7 Event Handler

The Planning and Scheduling subsystem uses the Event Handler to forward event messages by all P&S tools to the DMS Message Handling system. The Event Handler must be running on both the Data server and the Userstation. The Event Handler is started up as part of the login on the Userstation and as part of the start-up script on the Data server.

It is critical to run the Event Handler in the background while Scheduling tools are up and running. The Event Handler acts as a conduit to the event message display for all messages that are generated from Scheduling tools. Moreover, certain user errors are notified only via an event message. Lastly, event messages will not be archived off to the database if the Event Handler is not running. This will result in loss of all records of Scheduling activities performed.

8.1.4 Typical Scenario for use of Scheduling Tools

Prior to scheduling, the operational database must be populated with information necessary to schedule. This information includes activity definitions, Baseline Activity Profile (BAP) definitions, and constraint definitions. You will primarily use these tools early in the mission.

8.1.4.1 Define Activities, BAPs, and Constraints

Activity definitions can be created by using the Activity Definer tool supplied as part of the IST Toolkit on a Userstation. The primary purpose of activity definitions is to group together a set of commands in order to transition a resource from one configuration or mode to another. A resource is a representation of a physical or logical entity on a spacecraft, such as an instrument or spacecraft subsystem. Considerable time should be spent defining activities in order to reduce scheduling efforts and simplify constraint definitions.

Activity definitions are configuration controlled and cannot be modified directly from the operational database. Instead, activity definitions will be created using an unvalidated database and then validated before being used operationally. This is another reason why care should be taken in creating the definitions since the turn-around time for the modification of activity definitions may not be trivial. The Activity Definer tool is described in section 8.2.

BAP definitions can be created using the BAP Definer tool, supplied as part of the IST Toolkit on a Userstation. BAP definitions are a powerful way of scheduling a large number of activities without great effort. BAPs, unlike activities, can be modified at any time using the BAP Definer at either the EOC or an IST. The BAP Definer tool is described in section 8.3.

Constraint definitions are useful for preventing and alerting schedulers of resource or geometry conflicts. Constraint Definitions can be created, modified, or deleted using the Constraint Definer at either the EOC or at an IST. The Constraint Definer tool is described in section 8.4.

8.1.4.2 Ingesting New FDD Data

Other database information needed for scheduling includes additional planning aids generated by the Event Generator tool. The Event Generator uses ephemeris data obtained from the FDD to create additional orbital event data that is stored in the database. Later, the orbital events can be used to schedule activities. This data includes instrument ground target availability and sun-angle avoidance events. Additional planning aids are generated at the EOC after regular FDD planning aid generation, and are available for use in the same manner as FDD planning aids.

PAS scheduling tools use FDD data as the basis to enable you to choose orbital events to schedule activities against. The data sent by the FDD for the next day is predicted accurately; any data for future times is not always accurate enough and needs to be refined. As a result, activities scheduled on any plans by the scheduling tools, such as the General Scheduler, need to be adjusted based on the new data received from FDD every day to reflect more accurate orbital events.

The tools used for adjusting the scheduled start time of the activities already on the plans are the Event Generator tool and the Schedule Adjuster tool. The Event Generator creates and stores event information derived from FDD data. The Schedule Adjuster tool reschedules a plan's activities whose start and/or stop is predicated upon the occurrence of an event. In addition, the Schedule Adjuster also extends BAPs out to the end of available FDD data unless otherwise specified.

Operationally, these tools will run at the EOC in the background when FDD data is ingested into the system. Nominally, this will be done late at night when there are very few other processes running on the machine at the EOC.

NOTE

The Scheduling Name server, Resource Model, and Data Distributor processes must be running for the Event Generator and the Schedule Adjuster to run.

1. **Upon completing the validation of a batch of new FDD data by Data Management System (DMS), DMS triggers off the running of the Event Generator**. The Event Generator will run for an estimated period of about two-to-three hours depending on the amount of data available, but probably no longer than four hours assuming a minimally loaded system. The function of the Event Generator is described in section 8.4.1.

2. **Following the Event Generator, DMS triggers off the running of the Schedule Adjuster**. The Schedule Adjuster should run for a period of typically one-to-three hours. This period is dependent on how many activities are on the Master Plan, how many BAPs have to be scheduled and/or extended, and the activity complexity of the BAPs. The function of the Schedule Adjuster is described in section 8.4.2.

3. **When the Schedule Adjuster is finished, the Master Plan has been updated and saved to the database**. Any currently active resource models where the Master Plan is open will be updated with the Timeline reflecting those changes.

8.1.4.2.1 Event Generator

The Event Generator tool creates events using FDD data and instrument-provided data. The Timeline accesses these events to develop schedules like the ones received from the FDD. Each time new FDD data arrives, the EOC Data server process that validates and ingests the data will automatically run the Event Generator. In special situations, you may run it via the command line by executing the startup script st_eg on a UNIX terminal command line from the directory designated by the STARTUPFILELOC environment variable in the EOC, as follows:

cd $STARTUPFILELOC

st_eg.

Make sure you run the Planning and Scheduling Schedule Adjuster tool (see paragraph, 8.1.3.2.2), after the Event Ingester, to ensure that the new events are ingested into the resource model. The Timeline must re-access the event list each time the tool is run. The Event Generator creates two categories of events: CERES Solar Avoidance Events and Target Visibility Events.

8.1.4.2.1.1 CERES Solar Avoidance Events

CERES schedules solar evasive activities based on CERES Solar Avoidance Events. In CERES biaxial scan mode there is danger of direct solar viewing in two ways.

The first involves CERES' back and forth scanning motion, during sunrise and sunset. If the scan extends beyond the earth's limb during these periods, the sun may enter its field of view. To avoid this, CERES implements a "short scan" activity. The solar elevation angle values determine the times at which these activities should be scheduled. The Event Generator reads these elevation angle values from the FDD data tables and creates events from which CERES may schedule its short scan activities. The tool creates three events for each endangered time span: one discrete event at the entry into dangerous angle values, one discrete event at the exit from the dangerous values, and one event spanning the duration of the dangerous values. You may schedule from the two discrete events; the duration event is strictly for Timeline viewing.

The second danger of direct solar viewing is through CERES' circular rotation. When the solar beta angle reaches certain limits, an activity restricting rotation to some value less than 180 degrees must be scheduled to avoid solar viewing. The Event Generator tool reads the solar beta angle values and creates events in the same way previously described for the elevation angles. Beta angle restrictions occur once or twice a year, whereas elevation angle restrictions occur every sunrise and sunset.

8.1.4.2.1.2 Target Visibility Events

Target Visibility Events occur when a certain point on the earth (target) is visible to an instrument. Each instrument may provide a list of target information to be maintained in the database. You may also run the tool manually to create events for file-defined single targets. Running the tool for a

single target via file input quickly generates a visibility event for a new target without having to update the database and regenerate events for the entire list (e.g., generating visibility events for a sudden area of interest, such as a volcano). The Event Generator tool reads the spacecraft ephemeris and target site information from the database and, depending on the method of calculation, a footprint defining file provided by the instrument team. The tool then generates Target Visibility Events based on these inputs. The visibility of targets to the instrument may be calculated in two ways: Closest Approach or Within a Footprint.

8.1.4.2.1.3 Target Closest Approach

The Target Closest Approach method uses the **Extent** field within the instrument team-provided list of targets. Extent defines the maximum distance (in kilometers) the target may be from spacecraft nadir at its time of closest approach for the Event Generator to create an event. The tool generates one discrete event when the spacecraft nadir point's closest approach to the target is within this extent distance of the target.

8.1.4.2.1.4 Within a Footprint

The second method requires a file provided by the instrument team containing footprint data expressed in rotation and half angles to define a polygon. The rotation angle is the clockwise rotation from the velocity vector of the spacecraft around the nadir vector. The half angle is the angle from the nadir vector (see Figure 8.1.4.2.1.4-1). The environment variable CONFIG_DIR specifies the directory where these footprint files reside. Using ephemeris and target data, the Event Generator will create visibility events: a discrete event when the target enters the footprint, a discrete event as it leaves, and an event spanning the duration between. Like the CERES events, you may only schedule from discrete events, the other is strictly informational.

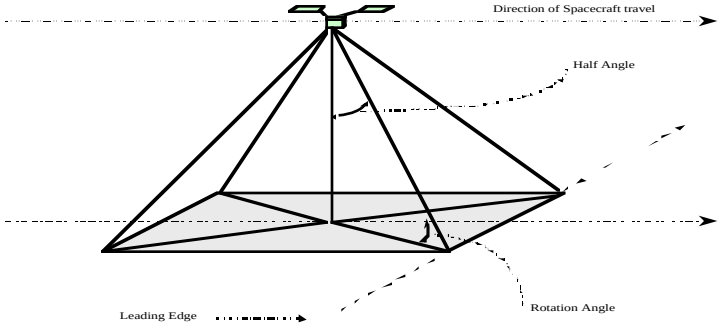


Figure 8.1.4.2.1.4-1. Instrument Footprint Model

8.1.4.2.1.5 Event Generation Process

DMS validates new FDD data and places it into tables. The EOC Data server will automatically run the Event Generator executable by executing the UNIX startup script from the scripts/setup directory in the EOC (before the Schedule Adjuster). The Event Generator creates the target visibility and CERES solar avoidance events for the Timeline to display. The EOC Data server will then automatically run the Schedule Adjuster script, resetting activities using the modified event data and times. If required, the Event Generator may be run manually via the command line (see section 8.1.4.2.1).

8.1.4.2.1.6 Instrument Target Sites Input

The instrument team must supply, via ftp to DMS, a list of targets to generate target visibility events from database target values. A script then runs, inserting the targets into the database table. The Event Generator tool will access the database table. The instrument team may submit an updated file of target sites at any time.

NOTE

The changes will completely overwrite the previous target site data and the changes will not go into effect until the next time the Event Generator tool runs (when new FDD is received).

The list must contain the following values:

a. target_name Name of target site.

b. target_id Id of target site.

c. instrument Instrument name.

d. latitude Latitude of the target site.

e. longitude Longitude of the target site.

f. altitude Altitude of the target site.

g. type Type of target.

h. extent Distance of spacecraft nadir to the target for which events shall be generated. This value is only used for the Closest Approach method of calculation. If you are using the Within Footprint method of calculation, this value will not matter, but a number greater than zero must be entered in the field.

Each line of the input file must contain a return (a real, executed return, not the return character "\n") at the end of the line. Each line of the file must be in the following format:

target_name target_id instrument latitude longitude altitude type extent comments

No fields, except the comment field, may have spaces within the string, express a space by an underscore (_). All fields (except the comment field) must exist and be separated by one space. If there is no comment there must be ONE space following the extent value. The comment field in the database table will then contain a value of NULL. If there is no comment and no spaces exist after the extent value, the file will not be read in properly. If multiple spaces exist after the extent field, the comment field in the database will contain spaces instead of NULL. The format for the name of this file is: <first four letters of instrument (in all capitals)>_tgt_sites_input. **Valid file names are**:

MISR_tgt_sites_input

MODI_tgt_sites_input

CERE_tgt_sites_input

MOPI_tgt_sites_input

The following text is an example of a target site input file. Spaces are expressed as an asterisk (*) for clarification. This example contains four lines:

Greenland*MISR_OO1*MISR*75.0*-40.0*0.0*SCI*500.0*

Beaufort_Sea*MISR_OO2*MISR*73.00*-140.00*0.0*SCI*500.0*

Norweg_Sea*MISR_003*MISR*65.00*-5.00*0.0*SCI*500.0*

StatCol,_PA*MISR_014*MISR*40.70*-78.00*0.0*VAL*100.0*CLOUD VAL

Restrictions on field lengths and types are as follows:

a. target_name — 12-character string or less (no white space).

b. target_id — 8-character string or less (no white space).

c. instrument — 6-character string or less (must be all in capitals and one of the following: MISR, CERES, MOPITT, MODIS).

d. latitude — 8-digits (or less). Must be a number, decimal or integer, between (inclusive) -90 and 90.

e. longitude — 8-digits (or less) (Must be a number, decimal or integer, between (inclusive) -180 and 180.

f. altitude — 8-digits (or less). Must be a number, decimal or integer, 0.0 corresponds to sea level.

g. type — 3-character string or less (no white space).

h. extent — 8-digits (or less). Must be a number, decimal or integer, greater than zero.

i. comments — 255 character string or less (may contain spaces, but not returns).

NOTE

No target may have the same name, instrument, and type combination as another target.

No target may have the same target_id and instrument combination as another target.

If any of the constraints are violated, errors will exist and no data will be entered in the table for the offending instrument.

8.1.4.2.1.7 Target Visibility Events From a File

As previously mentioned, the Event Generator can also create events for single targets whose information is contained in a file. Running the tool for a single target via file input generates a visibility event for a new target quickly, without having to update the database and regenerate events for the entire list. This is useful when generating visibility events for some sudden area of interest, such as a volcano eruption. When it is necessary to generate visibility events immediately for a new target, from a target file, a script present in STARTUPFILELOC runs the tool from the command line.

cd $STARTUPFILELOC

st_eg.

Since running the tool in this way only adds new events and does not "reschedule" any already existing events, the Schedule Adjuster tool does not need to be re-run; however, you must have the Timeline re-access the event list. To create visibility events for targets not contained in the database, you must define all target information within a target information file. Express spaces within any field as underscores (_).

8.1.4.2.1.8 Closest Approach Method

Run the script from the command line followed by the name of the target information file. The target information file for the Closest Approach method must contain the extent distance. The extent is the maximum distance (in kilometers) the target may be from spacecraft nadir at their time of closest approach for the Event Generator to create an event.

The format for the target information file for this functionality is:

Target latitude value

Target longitude value

Target altitude value

Target name

Target type

Instrument name

Extent distance

Example Target Input File:

20.00

50.00

0.000

Saudi_Arabia

OIL

MISR

100.000

8.1.4.2.1.9 Within Footprint Method

Run the script from the command line followed by the name of the target information file. The target information file for the Within Footprint method must contain the path and filename of the footprint defining vectors. If the instrument already has a footprint file defined, the environmental variable, CONFIG_DIR, specifies the directory where the footprint file resides. If the instrument does not have a footprint file defined, one must be created.

The footprint defining file contains footprint data expressed in rotation and half angles (in radians) to define a polygon. The rotation angle is the clockwise rotation from the velocity vector of the spacecraft around the nadir vector. The half angle is the angle from the nadir vector (see Figure 8.1.4.2.1.4-1).

The format for the footprint defining file is:

rotation angle

half angle

rotation angle

half angle

rotation angle

half angle

rotation angle

half angle

Example of a Footprint Input File:

1.3866

2645

1.7550

2645

4.5282

2645

4.8966

2645

The format for the target information file for this functionality is:

Target latitude value

Target longitude value

Target altitude value

Target name

Target type

Instrument name

Footprint values input filename

Example Target Input File:

38.00

15.00

0.000

Mt_Etna

VOL

MISR

/ecs/formal/fos/pas/eg/data/footvecs

8.1.4.2.2 Schedule Adjuster

The Schedule Adjuster tool is a non-GUI tool run in the background. Its function as previously detailed is to schedule BAPs, reschedule non-BAP (deviation) activities, and extend BAPs on the Master Plan. The Schedule Adjuster requires, at minimum, the presence of a Resource Model and Scheduling Name server in order to run.

8.1.4.2.2.1 Invocation

Invocation of the Schedule Adjuster is done via a script st_sa found in the directory designated by the STARTUPFILELOC environment variable from the UNIX command line. **Its usage is as follows**:

```
cd $STARTUPFILELOC
```

st_sa [-StartTime sTime] [-EndTime eTime] [-UpdPlanNm updPlan]

where the optional arguments are:

-sTime <Start Time of the span on the plan you want to schedule over>

-eTime <End Time of the span on the plan you want to schedule over>

-UpdPlan <Name of the plan to be updated; usually the Master Plan>

Both -StartTime and -EndTime arguments, when specified, must follow the date/time in FDD format, that is: YYYYDDD.HHMMSS. The end time cannot be earlier than the start time.

Depending on the arguments that you specify, the time span selected for rescheduling of events is determined as described below in section 8.1.3.2.2.3.

8.1.4.2.2.2 Description of Scheduler Adjuster Functionality

The following sections describe the scheduling of BAPs and the rescheduling of non-BAP (deviation) activities. The Schedule Adjuster schedules BAPs and reschedules all deviation activities whose start time is based upon an event (rather than an absolute time), using the new data received from FDD; it uses Non-Impact Scheduling and does not allow oversubscribing. The span over which these operations may occur is dependent on the determination of Start Time and End Time.

8.1.4.2.2.3 Start and End Time Specification

The start time of the scheduling span is determined as follows:

1. If you do not specify a -StartTime argument and if you are working on the Master Plan, then the start time used will be the last DAS time of the Master Plan. If you are working on a What-If plan then the program will print out a message and terminate.
2. If you do specify a start time and if you are working on the Master Plan, then the start time used will be the earlier of two times: the argument's value and the last DAS time. If you are working on a What-If plan then the start time that you specified in the command line will be used; otherwise, the last DAS time from the Master Plan will be used as the start time.

The end time of the scheduling span must be later than or the same as the start time chosen as described above, and is determined as follows:

1. If you do not specify an -EndTime argument, the end time will default to the chosen value of the start time plus seven weeks. This figure is based upon the premise that FDD data is supplied in blocks of up to seven weeks.
2. If you specify an end time, the value must be the same as or later than the evaluated start time value. If you do not do so, the program will display a message and terminate.

If you do not specify a start time but you do specify an end time, it is recommended that you specify a time later than the last DAS time of the Master Plan. The default condition assumes you are working on the Master Plan with the scheduling span ranging from the last DAS time to the last DAS time plus seven weeks.

The recommended choice of start an end times is driven by performance/time criteria and the number of activities scheduled based on events. In general, the wider the time span and the greater the number of activities scheduled based on events, the more time it will take to do the job.

8.1.4.2.2.4 BAP Scheduling and Extension

The choice of BAPs to be scheduled and/or extended is decided based on their install time on their particular resource and the choice of the start and end time chosen previously. The install time of BAPs dictate when the scheduling may start within a given span.

The selection of the first BAP to get scheduled on a particular resource is the one whose install date is the same as the chosen start time and scheduling will start from the same time. If one such as that is not available, then the next preference is a BAP whose install date is the nearest one to the chosen start time and earlier than it. If this is the case then the actual scheduling period will start from the install time of this BAP. If neither of the previous types of BAPs are available then no BAPs for these resources are scheduled.

The scheduling for this first BAP will be from its install date to the install date of the next BAP to be scheduled on the same resource. If there is no subsequent BAP then scheduling will continue "extended" until the chosen end time. However, if there are other schedulable BAPs on the same resource, they will be scheduled in a similar manner as the first one starting with its install date. The last BAP scheduled will always be the one that gets extended to the chosen end time.

The above procedure is repeated for BAPs on all the spacecraft resources.

8.1.4.2.2.5 Rescheduling of non-BAP activities

Since non-BAP activities do not have install times, the actual period over which rescheduling will occur is always the same as the time span you specified using the start and end times.

8.1.4.3 Schedule Activities for the Day

8.1.4.3.1 Use the Timeline Tool

In order to view what each EOS instrument and subsystem is doing, use the Timeline tool. The Timeline is the Scheduling subsystem's main visualization tool and is used to display plans. Plans are a collection of scheduled activities and the resulting state of resources modeled within the Planning and Scheduling software. To view a plan, run the Timeline and open it the same way a word processing application opens a document. It is recommended that you always have a Timeline running while performing scheduling functions in order to see modifications to plans (made by you or another user). In fact, it is necessary in most cases to have the Timeline running in order to schedule since you must open a plan first. The Timeline tool is highly configurable to individual users' needs, so take advantage of this. Mastering the Timeline's capabilities will make scheduling easy and prevent conflicts by allowing you to see them before they occur.

8.1.4.3.2 Schedule Your BAPs

Once database information is created and the core processes are running, normal day-to-day scheduling may be performed. Instrument teams located at IST sites will most likely (although not required) establish instrument operations by first scheduling a baseline set of activities defined in a BAP.

BAP scheduling may be performed automatically by "installing" a BAP at a given start time, which will schedule activities onto the EOC's "Master Plan" at an FOT-defined time during the operational day. A background process run at the EOC, the Schedule Adjuster, is responsible for scheduling and extending BAPs. BAPs may also be scheduled by hand at IST sites using the General Scheduler.

8.1.4.3.3 Schedule ASTER Activities

The ASTER instrument will schedule its activities using the File Scheduler background process, along with the File Scheduler poller. The File Scheduler takes scheduling requests in the form of an ASCII file (following the ASTER-FOS ICD), replaces the time-span specified in the header of the request file (whether it is an STS or ODS), and schedules all activities specified in the file. Updates are then distributed normally to all ISTs and the EOC.

8.1.4.3.4 Schedule Deviations to Your Baseline

After a baseline set of activities has been scheduled, you may use the General Scheduler tool to add additional activities to the schedule. The General Scheduler is available at both the EOC and ISTs for all forms of scheduling, with the exception of contact and load scheduling. Most instrument teams will only need to run the General Scheduler and a Timeline to perform daily (possibly only weekly) scheduling operations. The General Scheduler is capable of scheduling pre-defined activities, BAPs, individual commands, and command procedures and is therefore the most common scheduling utility.

8.1.4.3.5 Schedule Communication Contacts and Coordinate with NCC

Once most of the schedule has been developed into a plan, a contact schedule will be generated at the EOC by the FOT using the Contact Scheduler tool. The Contact Scheduler should be used to automatically schedule a batch of contacts. You may also schedule individual contacts as required. Once contacts are scheduled, you should verify that the Solid State Recorder buffer levels are sufficiently low. You can manipulate the schedule by moving individual contacts or scheduling additional ones as required for optimizing buffer levels.

It is important to get the schedule the way you want it before submittal to the NCC, since contact activities will be locked after submission and you must go through an NCC delete request for changes. The NCC Ingester tool running in the background will automatically update the Master Plan with responses from the NCC, so you should check the plan daily for rejected contact requests in order to reschedule them as soon as possible.

8.1.4.3.6 Schedule Load Uplinks

After contacts are scheduled, the Load Scheduler can be used by the FOT at the EOC or an IOT at an IST to schedule loads for the spacecraft whether they are flight software, table, or instrument microprocessor loads. ATC loads are scheduled automatically when a load is generated so they are not handled by the Load Scheduler tool.

8.1.4.3.7 Generate the ATC Load and the Ground Schedule

Once scheduling is done for a particular target day, the ATC Load and the Ground Schedule are generated using the Load Generator tool. The FOT should tell users at the ISTs when they are generating a load since no changes can be made to the target day on the Master Plan without going through the late change process.

8.1.4.3.8 Handle Late Changes

It is inevitable that, in some situations, either instrument teams or the FOT will need to make changes to the schedule after the ATC load has been generated. Instrument teams must contact the FOT at the EOC to unlock their resource using the Load Generator tool since users at ISTs will not have the capability to do it themselves. Refer to the User roles mentioned in section 8.5.10. Since changes made to the schedule after load generation could cause conflicts, care must be taken in making such changes. Any conflicts arising from a late change must be resolved.

Once a resource has been unlocked, instrument teams at the ISTs can use the General Scheduler and Timeline to update their schedule. They then notify the FOT that the change has been completed so the FOT can regenerate the ATC load.

8.1.5 Setting up Run-Time Environment

The following information is provided to help you set up the run-time environment properly for your needs.

When you select a Scheduling tool from the TOOLs menu on the Control Window, the Scheduling tools are started using scripts located in the directory designated by the STARTUPFILELOC environment variable. The startup script names follow the naming convention st_XX, where XX represents a two character designator for each tool. The startup scripts for all tools use a script called “setup”. Some of the startup scripts also use environment variables defined in other scripts as command line arguments. An example of such script is the file “pas_stdArgs” which defines command line argument values used by all the Scheduling tools. The setup file uses two other files: setup.$SITE and setup.$USER, where the SITE environment variable represents the name of the site, such as EOC, and the USER environment variable represents your user-id.

The use of the setup file and other scripts such as pas_stdArgs has proved to be very valuable in Integration and Testing in several different environments. These will also provide a lot of flexibility and convenience to the maintenance team in case there are enhancements to be made and tested. It is imperative that users should not change the settings provided in the setup file, after the system is initially installed and tested. This is because the values of the environment variables are set precisely so that all tools and their external interfaces work together in harmony. Changing any

parameters without understanding the implications of the change may result in unpredictable outcomes and hinder your work.

The changes that may be made to the setup files can be categorized as follows: Baseline setup, Site Customization, and User Customization.

Baseline setup consists of setting up value of the very basic set of environment variables, such as those required for starting an appropriate name server, and those required by the Load Queuer and SSR Updater tools. These values are all set in the file named "setup". This file assumes that you will always be operating using the Sybase tables. This file is to be modified only by the Maintenance team. **YOU MUST NOT** make any changes to this file.

Site Customization environment variables are specified in the setup.$SITE file. This file contains variables that specify the names of the directories where the various executable and input files are to be found, variables that define the external interfaces for NCC communications, variables that specify names of printers to be used, and variables that specify names of directories where the data sent from ASTER AGS is received. Variables in this file should be setup initially and tested by the Installation team/Maintenance team, and then controlled strictly using configuration control procedures as mentioned in section 8.1.1 above.

User Customization setup file is used to set up values that you can change to appropriately set up your mode of operations (Test or Ops), user role and date type format. To do this, you create a file called setup, your user id in your home directory. In this file, you will normally set up values of the two variables USERROLE and DATETYPE, as follows:

```
setenv MODE TEST

setenv USERROLE DEFINER

setenv DATETYPE DayOfYear
```

The valid options for the MODE variable are TEST and OPS. The valid options for the USERROLE variable are DEFINER, SCHEDULER, etc. The valid options for the DATETYPE variable are DayOfYear, MonthDayYear, and DayMonthYear. Once you have selected the desired datetype, you will see the dates in that format on all tools; you must also enter dates in the same format on all Graphical User Interfaces. It is recommended that you choose your preferred DATETYPE once and use it in all your Scheduling work. In addition, you may setup the name of the printer where you can conveniently print the output from the Timeline tool, as follows:

```
setenv theLetterPrinter yourPrinterName
```

8.2 Defining Activities

The Planning and Scheduling subsystem provides an Activity Definer tool to define activities to be scheduled in the system. Activities will generally be defined at the beginning of a mission to group together commands and mode transitions into logical units. The Activity Definer allows authorized users to specify commands in the activity, relative start/stop times, and individual parameters. Additionally, users will specify mode transitions triggered on the resource by executing the activity. Menu selections are provided to: create a new activity; open a given activity; close an activity; save an activity; save an activity under a different name; and delete a given activity. In

addition, users may create, edit, and modify contents of an activity such as command procedures, mode transitions, complex activities, ECL directives, command parameters, and activity scheduling information. The Activity Definer will automatically attach a version number to the activity name when the activity is saved. The version number of a newly created activity start with a 1. This version number will automatically be incremented by one each time the activity is saved. Figure 8.2-1 presents the Activity Definer window.

Authorized users may delete an activity definition no longer required. Remember that any modifications to activities, including creating new activities, and deleting existing one, done using the Activity Definer tool modify the test database. You must follow procedures set up by the Configuration Control Board to update the Project database from the test database. Refer to section 8.1.1.

To start the Activity Definer:

1. Click **Tools...** on the Control window.

   The Tools dialog box opens up.

2. To filter the Scheduling tools only, Select **Planning and Scheduling** from the Tool Type option menu.

3. Select **Activity Definer** from the list of Planning and Scheduling tools.

4. Click **OK**.

The Tools dialog box closes and the Activity Definer starts up.

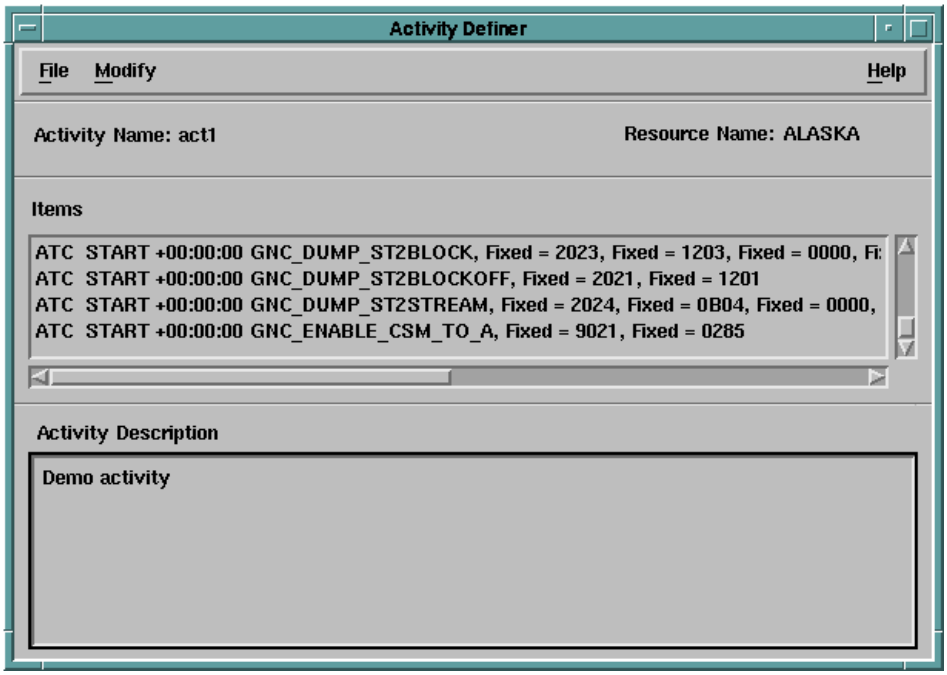


Figure 8.2-1. Activity Definer Window

8.2.1 Creating an Activity

You are required to set three parameters to create a new activity: an activity name, a resource, and an activity type. You specify the name when creating the activity, and select the resource from the list of resources in the pop-up menu. An activity may be one of the following types, provided on another pop-up menu: Standard, TDRSS contact activity, Ground contact activity, Slew activity, and Uplink activity. When you set these parameters and create an activity, the activity is a Label activity since it does not have any commands, ECL directives, other activities, or modes in it. You can save it into the test database or continue to populate commands, ECL directives, modes on a resource in the activity.

To create a new activity:

1. Select **New…** from the Activity Definer File menu.

   The New dialog box opens (see Figure 8.2.1-1).

2. Enter a new activity name.

3. Select a resource from the list of resources in the option menu.

4. Click on the Activity Type pop-up menu and select an activity type. The default will be shown based on the resource selected.

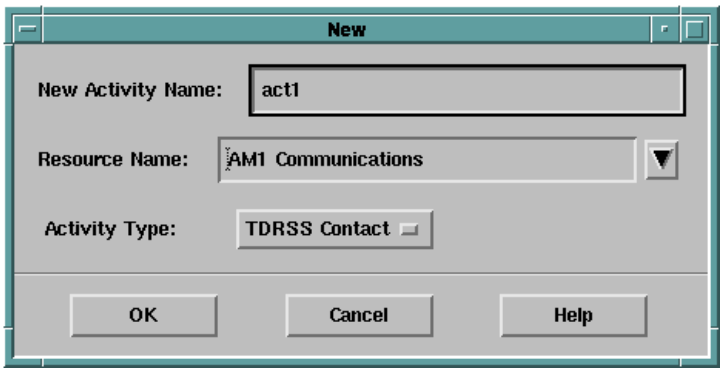


Figure 8.2.1-1. New Activity Dialog Box

5. Click **OK**.

   The New dialog box closes.

   The activity name and its associated resource name appear in the top of the Activity Definer window.

6. Enter an activity description in the Activity Description text field at the bottom of the window (optional).

7. Select **Save** from the File menu.

   The activity is saved to the test database via the resource model.

8. Select **Close** from the File menu.

NOTE

Most activities will be default to the **Standard** type. Other types are communication contact activities and services. Refer to section 8.2.2.6 for detailed descriptions of these activities.

8.2.2 Modifying Activity Fields

To modify a activity you must first open it, make any required changes, and then save the activity. To modify a activity, you must be authorized to make modifications to existing activities. Once an activity is opened, you may modify activity fields using options available from the Modify menu

8.2.2.1 Open an Activity

To open an activity:

1. Select **Open…** from the File menu on the Activity Definer Window.

   The Open dialog box opens (see Figure 8.2.2.1-1).

2. Select a Resource Name to filter activities.

Activities associated with the selected resource are displayed on the Activity Names list.

3. Click on the desired activity from the Activity Names list.
4. Click **OK** to accept the activity. The Open dialog box closes.

   or

   Click **Apply** to apply the changes. The dialog box remains open for editing. The activity and resource names appear in the top of the Activity Definer window.

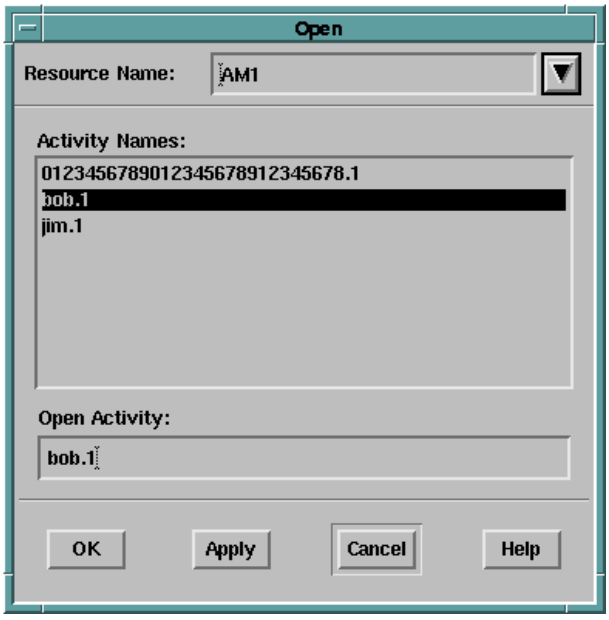


Figure 8.2.2.1-1. Open Activity Dialog Box

8.2.2.2 Editing Commands in an Activity

To edit and populate commands in an activity:

1. Select **Commands…** from the Modify menu on the Activity Definer window.

   The Commands dialog box opens (see Figure 8.2.2.2-1).

2. Select **ATC Command** or **Ground Command**. An ATC command gets included in the ATC load that is uplinked, and is executed on board the spacecraft by the ATC processor. A ground command is executed on the ground during the real-time pass by the ground script processor.
3. Select a resource to filter on commands associated with that resource.

   Click on the desired command from the Available Commands list.

4. Click **Start** to schedule the command to execute at a time relative to the activity start time. Click **Stop** to schedule the command to execute at a time relative to the activity stop time.
5. To add the offset time to the start or stop time, select the **+** radio button. To subtract the offset time from the start or stop time, select the **-** radio button.
6. Enter an offset time in HH:MM:SS format.
7. Click **Add**.

   Repeat the previous steps for all commands to be included in the activity.

Optional procedure for removing an existing command:

8. Click on a command from the Selected Commands list.
9. Click **Remove**.

Optional procedure for replacing an existing command's associated values:

10. Click on a command from the Selected Commands list.
11. Modify any part of the command's associated values.
12. Click **Replace**.
13. Click **OK**. The Commands dialog box closes.

    or

    Click **Apply** to keep changes and leave the dialog box open for editing.

    The Items list on the Activity Definer window is updated with the revised values.
14. Select **Save** under the File menu to save the changes to the test database.

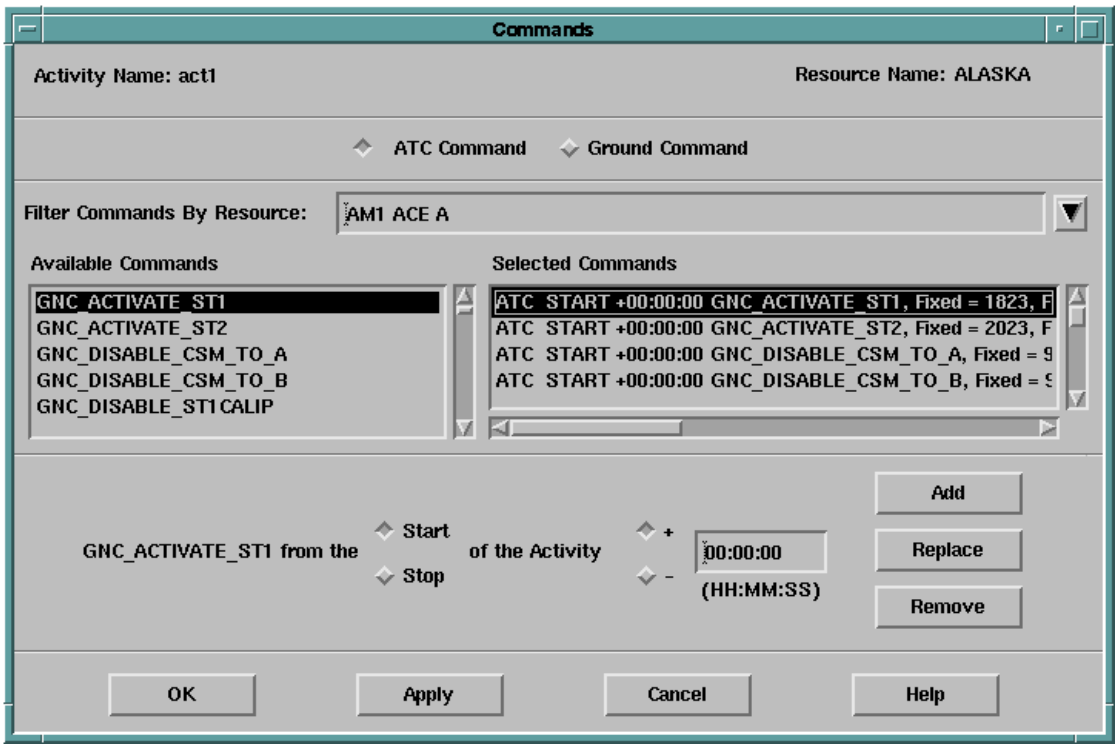


Figure 8.2.2.2-1. Commands Dialog Box

8.2.2.3 Editing Command Parameters

Command parameters are sometimes referred to as submnemonics.

To edit and populate command parameters (submnemonic values):

1. Select **Parameters…** from the Modify menu on the Activity Definer window.

   The Parameters dialog box opens (see Figure 8.2.2.3-1).

2. Select the command for which you want to modify the default value of the parameter.

   The command parameters appear in the Parameters list in the bottom left half of the display.

3. Select the parameter that you want to modify.

   For int or float type parameters, the default value of the parameter appears in the bottom right half of the display, along with the high and low limits. For discrete type parameters, the default value and a list of valid values appear as a value-selectable list.

4. For int or float type parameters, specify the desired new value. If you specify a value which is out of range specified by the high and low limits, you will be notified with appropriate error message. For discrete type parameters, you can choose only from the list of provided values.

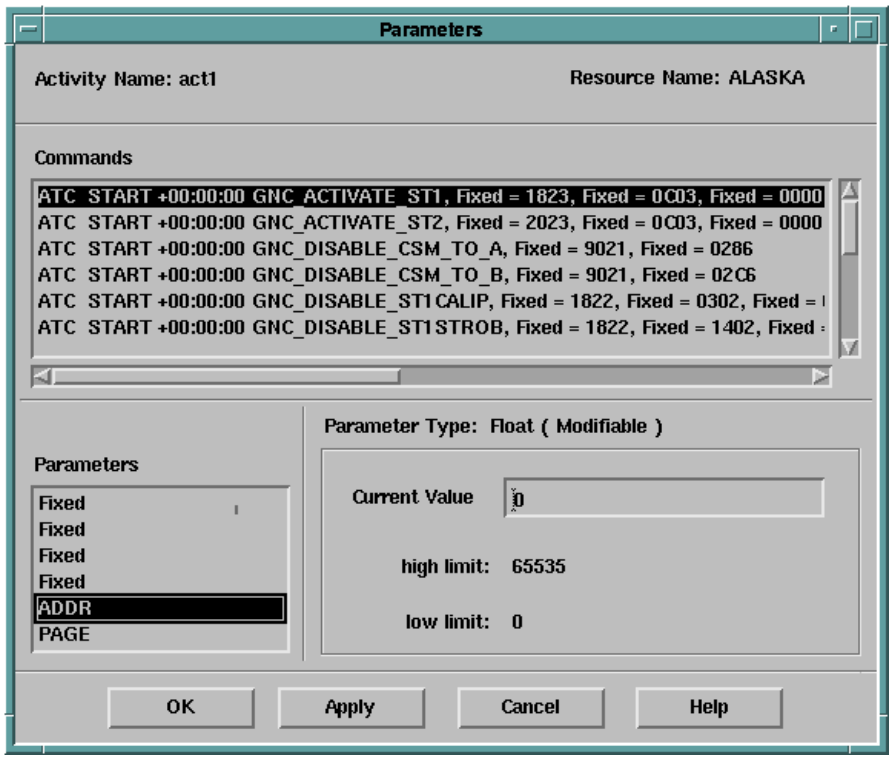


Figure 8.2.2.3-1. Parameters Dialog Box

5. Click **Apply**.

   Repeat the previous steps for all parameters to be respecified in the activity.

6. Click **OK**. The Parameters dialog box closes.

7. Select **Save** under the File menu to save the changes to the test database.

8.2.2.4 Editing Mode Transitions in an Activity

Mode is a state on a resource (the spacecraft or on one of its instruments). Commands in an activity may cause a resource to go from one mode to another. Modes are also used for checking constraints when scheduling an activity. Mode transitions of instruments are specified for each activity to model normal occurrences when commands within the activity are executed. These mode transitions are used to calculate the power and data rate for displays on the PAS Timeline. Modes will be shown along with the activity on the Timeline to provide operators with a better understanding of impacts to the resource caused by the activity's execution.

Modes must be explicitly entered in the activity definition. Otherwise, mode transitions caused by the activity will not be shown on the PAS Timeline. Moreover, power and data rates will be incorrectly calculated.

To edit and populate mode transitions in an activity:

1. Select **Modes…** from the Modify menu of the Activity Definer window.

   The Modes dialog box opens (see Figure 8.2.2.4-1).

2. Select a Resource to show only modes associated with that resource.

3. Click on the desired mode from the Available Modes list. This is the mode that the spacecraft or instrument will enter at the time of the mode transition.

4. Select **Start** to schedule the mode transition to occur at a time relative to the activity start time; select **Stop** to schedule the mode transition to occur at a time relative to the activity stop time.

5. To add the offset time to the start or stop time, select the **+** radio button. To subtract the offset time from the start or stop time, select the **-** radio button.

6. Enter an offset time in HH:MM:SS format.

7. Click **Add**.

   Repeat the previous steps for all mode transitions to be included in the Activity definition.

Optional procedure for removing an existing mode:

8. Click on a mode from the Selected Modes list.

9. Click **Remove**.

Optional procedure for replacing an existing mode's associated values:

10. Click on a mode from the Selected Modes list.

11. Modify the mode's associated values.

12. Click **Replace**.

13. Click **OK**. The Modes dialog box closes.

    or

    Click **Apply** to accept the mode's values and leave the dialog box open for editing. The Activity Definer window is updated with the revised mode transitions.

14. Select **Save** from the File menu to save the changes to the test database.

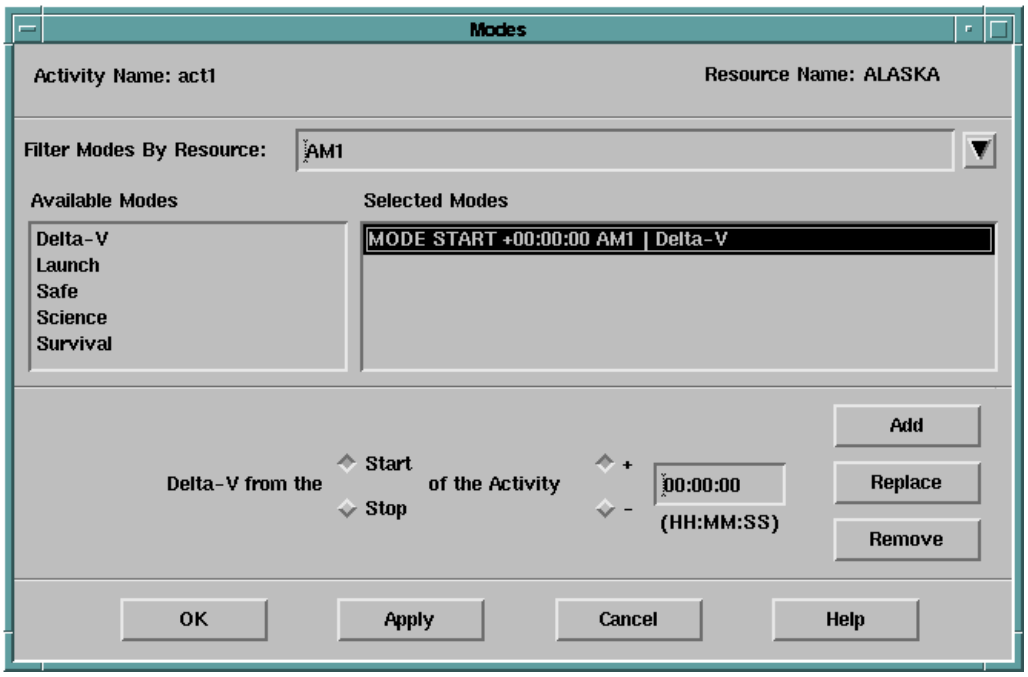


Figure 8.2.2.4-1. Modes Dialog Box

8.2.2.5 Editing Activities in a Complex Activity

Complex Activities are scheduling entities that may contain more than one activity definition. Within a Complex Activity, activity definitions are not restricted to a single scheduling component. For example, you can create a Complex Activity containing both a Solid State Recorder (SSR) activity and a Science Formatting Equipment (SFE) activity. The activity containing other activities is called the Parent Activity; the contained activities are called Children Activities. Once scheduled, an association is maintained between the parent and children activities requiring them to be rescheduled or deleted as a single entity. Note that complex activities differ from BAPs in that BAP activities are repetitive and do not maintain their association after being scheduled. In addition, complex activities may contain activities associated with different resources. This is not the case for a BAP which is restricted to a single resource.

When adding a new activity to a Complex Activity, the Activity Definer compares the mode transitions of the new activity with all existing mode transitions. If this causes in any overlapping of mode transitions on a resource resulting in a conflict, the Activity Definer will reject the new activity and display an error message indicating conflicting mode transitions. However, there is one case where the Activity Definer is unable to check for conflicts in mode transitions. This case occurs when a child activity's start time is based on the stop time of a parent activity. Since the stop time of the parent is most likely undefined, the child activity reference time will be undefined as well. As a result, the Activity Definer is unable to check for conflicting mode transitions within the child activity. A work-around for this case is to specify the start and stop time of the parent activity using the default scheduling information dialog box. Please note that this default

scheduling information can be changed at scheduling time. In other words, this work-around only guarantees conflict-free mode transitions with the default scheduling information.

To edit and populate activities within a complex activity:

1. Select **Complex Activities…** from the Modify menu on the Activity Definer window.

   The Complex Activities dialog box opens (see Figure 8.2.2.5-1).

2. Select a resource to show only activities associated with that resource.

   Click on the desired activity from the Available Activities list.

3. Select **Start** to schedule the complex activity to execute at a time relative to the start time of the activity; select **Stop** to schedule the complex activity to execute at a time relative to the stop time of the activity. To add the offset time to the start or stop time, select the **+** radio button. To subtract the offset time from the start or stop time, select the **-** radio button.

4. Select **Parent Stop** to specify the child activity stop time relative to the stop time of the Complex Activity. To add the offset time to the Parent Stop time, select the **+** radio button. To subtract the offset time from the Parent Stop time, select the **-** radio button. Enter Offset Time(s) in HH:MM:SS format.

   or

   Select **Duration** to specify the child activity duration. Enter an integer for duration with the proper unit selected.

5. Click **Add**.

   Repeat the previous steps for all activities to be included in the Complex Activity.

Optional procedure for removing an existing activity:

6. Click on an activity from the Selected Activities list.
7. Click **Remove**.

Optional procedure for replacing an existing activity's associated values:

8. Click on an activity from the Selected Activities list.
9. Modify any part of the activity's associated values.
10. Click **Replace**.
11. Click **OK**. The Complex Activity dialog box closes.

    or

    Click **Apply** to accept the activities entered and leave the dialog box open for editing.

12. Select **Save** under the File menu to save the changes to the test database.

NOTE

The number of activities in a Complex Activity should be limited to minimize impacts on other activities. This is because recursive activities are not allowed. Therefore, you will not be able to add an activity to itself or its parent activities to a Complex Activity.

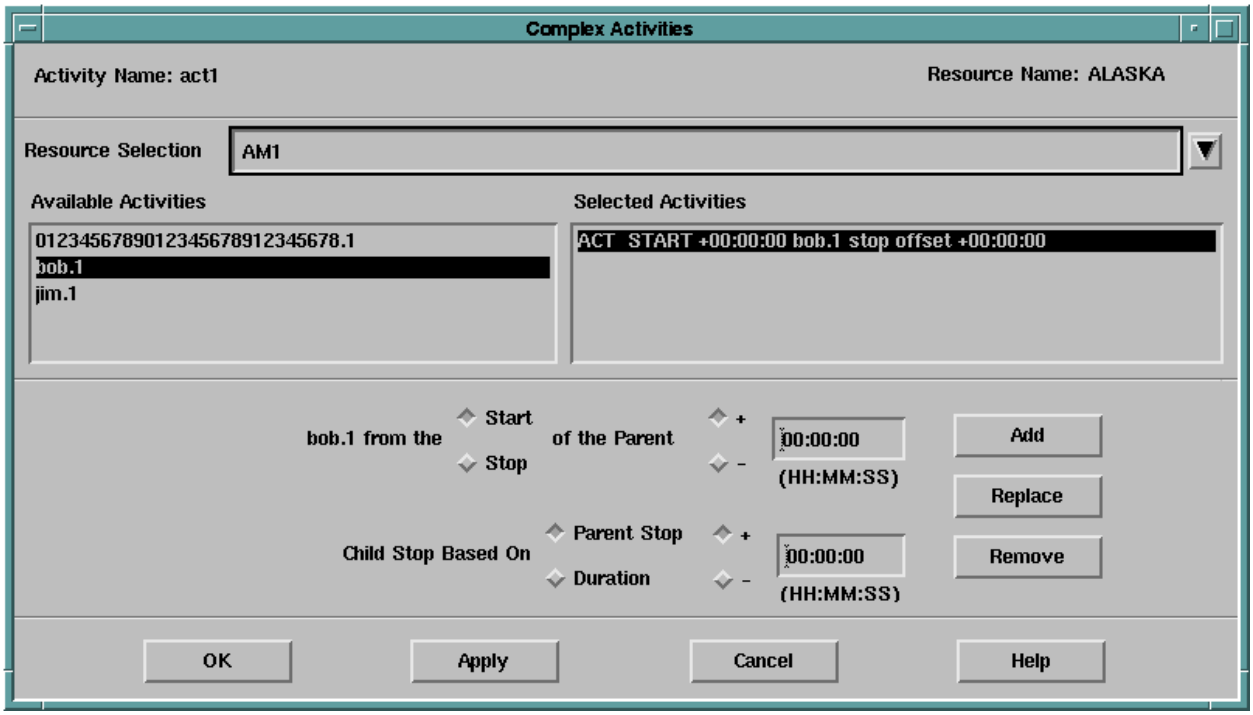


Figure 8.2.2.5-1. Complex Activities Dialog Box

8.2.2.6 Editing Communication Services in a Contact Activity

A communications contact activity represents a contact between AM-1 and a ground station. The contact may go via TDRSS or directly to a ground station. A complex activity of this type contains communications service activities.

A communications contact activity is a complex activity associated with a communications resource. You need to define separately several service activities so that the activity's resource is associated with a communications service such as uplink, downlink, TDRSS to ground station, or ground station to TDRSS. Each of these service activities will have an NCC configuration code associated with it corresponding to the NCC services such as MA Forward, SSA Return, etc.

You then use these service activities in the definition of the new communications contact activity. By using the service activities with proper configuration codes and appropriate time offsets from the start or end of the communications contact activity, you can define the communications contact activity so that you can use it almost like an NCC Prototype event. The communications contact activity thus defined will provide additional flexibility in that you can change the activity's time

duration and thus stretch or compress the services within it as you need when you schedule the activity.

Additionally, each TDRSS contact activity contains an NCC configuration code. The configuration code defines the contact's services, such as MA Forward, SSA Return, etc. When you create a new activity of the type "TDRSS Contact," the Modify menu's NCC option allows you to enter the NCC code. The system will not allow you to save the activity definition without first specifying its NCC code in the NCC Code Input dialog box (see Figure 8.2.2.6-1). Communications contact activities are scheduled using the Contact Scheduler tool.

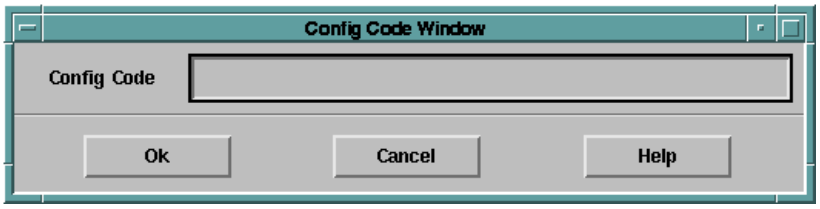


Figure 8.2.2.6-1. NCC Code Input Dialog Box

8.2.2.7 Editing ECL Directives in an Activity

To edit and populate ECL directives in an activity:

1. Select **ECL Directives…** from the Modify menu on the Activity Definer window.

   The ECL Directives dialog box opens (see Figure 8.2.2.7-1).

2. Enter an ECL directive in the ECS Command Language Editor box.

3. Select **Start** to schedule the ECL directive to execute at a time relative to the start of the activity; select **Stop** to schedule the ECL directive to execute at a time relative to the stop time of the activity.

4. To add the offset time to the start or stop time, select the **+** radio button. To subtract the offset time from the start or stop time, select the **-** radio button.

5. Enter an offset time in HH:MM:SS format.

6. Click **Add**.

   Repeat the previous steps for all directives to be included in the activity.

Optional procedure for removing an existing directive:

7. Click on a directive from the ECL Directives list.

8. Click **Remove**.

Optional procedure for replacing an existing directive's associated values:

9. Click on a directive from the ECL Directives list.

10. Modify any part of the directive's associated values.
11. Click **Replace**.
12. Click **OK**. The ECL Directives dialog box closes.

    or

    Click **Apply** to accept the ECL directives entered and leave the dialog box open for editing.

    The Activity Definer window is updated with the revised ECL directives.
13. Select **Save** under the File menu to save the changes to the test database.

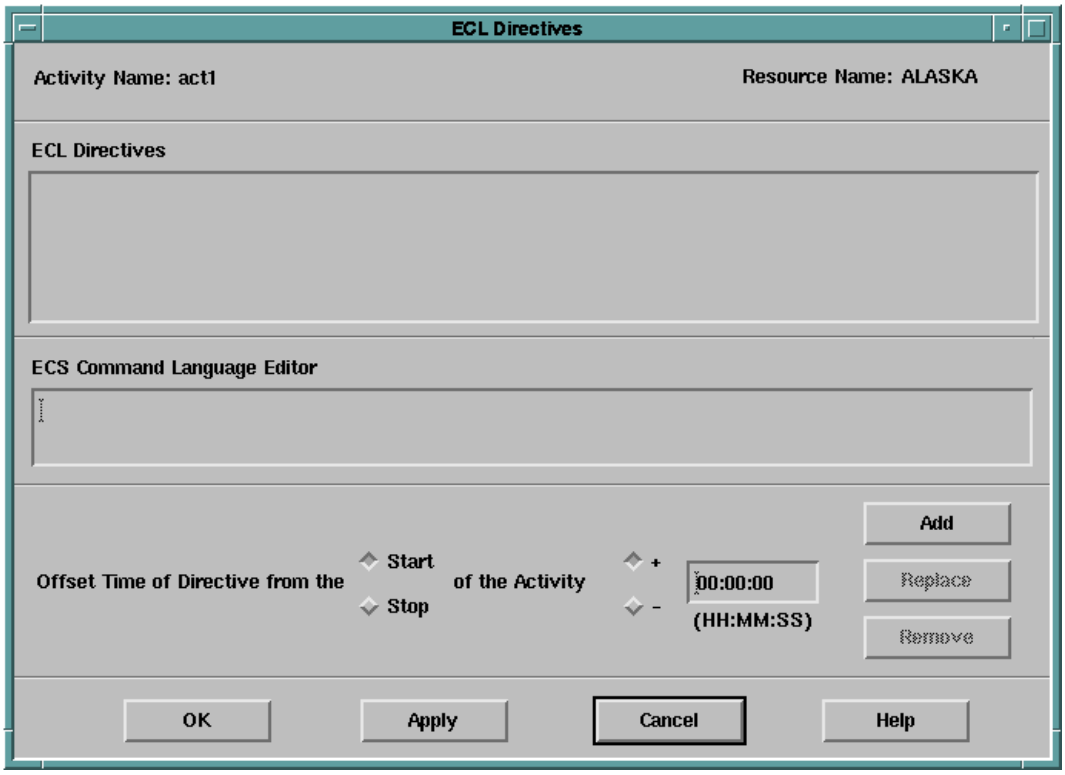


Figure 8.2.2.7-1. ECL Directives Dialog Box

8.2.2.8 Editing Command Procedures in an Activity

To edit and populate command procedures in an activity:

1. Select **Procedures...** from the Modify menu of the Activity Definer window. The Command Procedures dialog box opens (see Figure 8.2.2.8-1).

2. Click on the desired command procedure name from the Available Procedures list. A list of associated parameters and their values will be shown in the Parameters list. You may change those values if necessary.

3. Select **Start** to schedule the procedure to execute at a time relative to the activity start time; select **Stop** to schedule the procedure to execute at a time relative to the activity stop time.

4. To add the offset time to the start or stop time, select the **+** radio button. To subtract the offset time from the start or stop time, select the **-** radio button.

5. Enter an offset time in HH:MM:SS format.

6. Click **Add**.

   The procedure shows up on the Selected Procedure list with the proper reference time and parameter values.

   Repeat the previous steps for all procedures to be included in the activity.

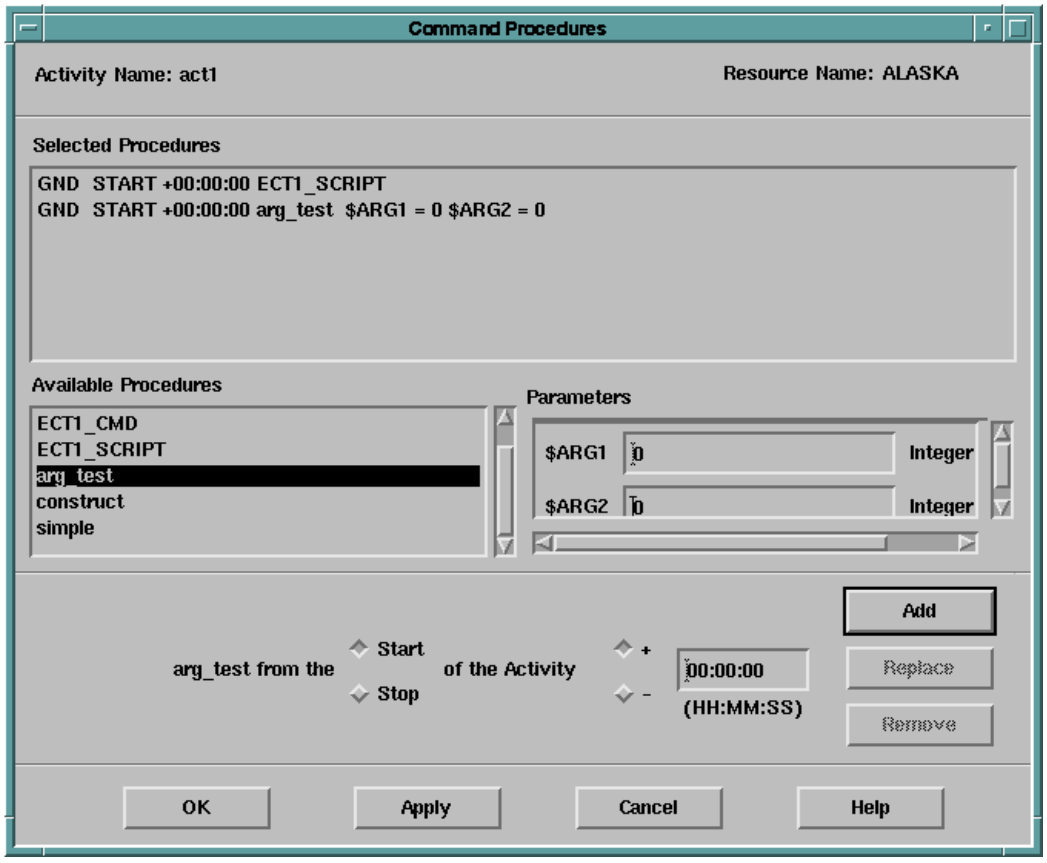


Figure 8.2.2.8-1. Command Procedures Dialog Box

Optional procedure for removing an existing command procedure:

7. Click on an activity from the Selected Procedures list.

8. Click **Remove**.

Optional procedure for replacing an existing command procedure's associated parameter or time values:

9. Click on a command procedure name from the Selected Procedures list.
10. Modify any part of the procedure's associated parameter or time values.
11. Click **Replace**.
12. Click **OK**. The Command Procedures dialog box closes.

    or

    Click **Apply** to accept the command procedures entered and leave the dialog box open for editing. The Activity Definer window is updated with the command procedures.
13. Select **Save** from the File menu to save the changes to the test database.

8.2.2.9 Editing Activity Scheduling Information

The Activity Definer allows default scheduling information to be saved along with the activity definition. The General Scheduler uses the default scheduling information to help you in scheduling the activity. For example, if start time of the activity is based on an event, the General Scheduler shows this on the display; you can then use this default or change it if required. The values entered here are default values that can be changed at scheduling time. Moreover, partial scheduling information is allowed. For example, you can specify a start time without specifying a stop time.

To edit activity scheduling information of an activity:

1. Select **Scheduling Info…** from the Modify menu on the Activity Definer window. The Activity Scheduling Information dialog box opens (see Figure 8.2.2.9-1).

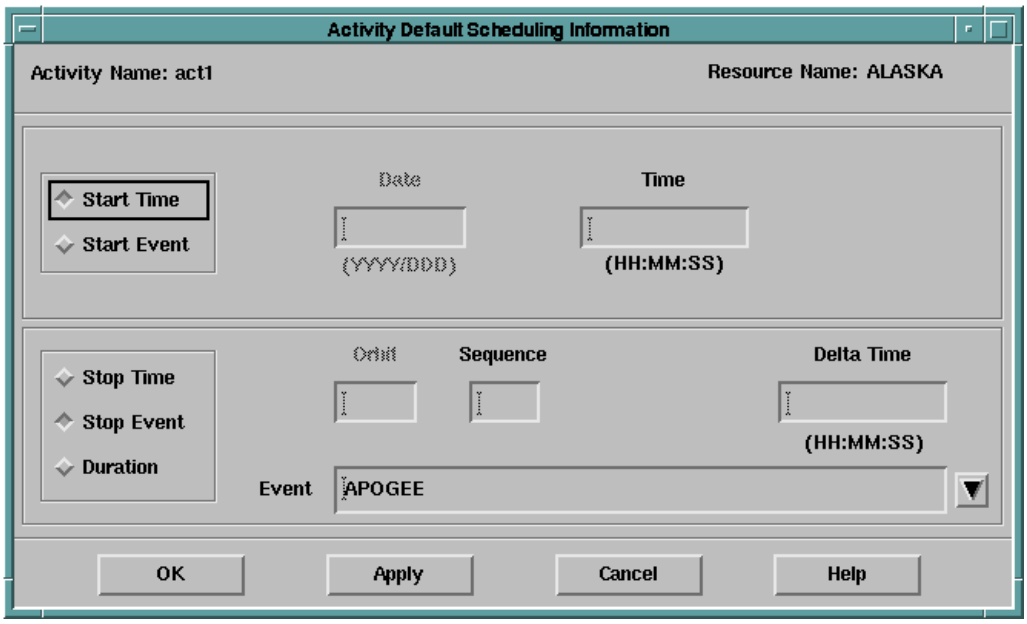


Figure 8.2.2.9-1. Activity Scheduling Information Dialog Box

2. Select **Start Time** or **Start Event** to enter default scheduling information for these items.
3. Select **Stop Time, Stop Event,** or **Duration** to enter default scheduling information for these items.
4. Enter the Date in the format: YYYY/DDD. For the Start Time/Stop Time selection only.
5. Enter the Time in the format: HH:MM:SS. For the Start Time/Stop Time selection only.
6. Enter the Orbit number of the default Orbit event. For the Start Event/Stop Event selection only.
7. Enter the Sequence number of the Orbit event. The sequence number is the number of occurrences of this event in the selected Orbit number. In most cases, this will equal 1. For the Start Event/Stop Event selection only.
8. Select an Orbit event from the Orbit event list. For the Start Event/Stop Event selection only.
9. Enter the Delta Time in the format: HH:MM:SS. For the Start Event/Stop Event selection only.
10. Select the Unit of the duration. Duration units include **Second**, **Minute**, **Hour**, **Orbit**, **HH:MM:SS**, and **MM:SS**.
11. Enter the Duration in the selected format.
12. Click **OK**. The Scheduling Information dialog box closes.

or

Click **Apply** to accept the scheduling information entered and leave the dialog box open for editing. The Activity Definer window is updated with the default scheduling information.

13. Select **Save** under the File menu to save the changes to the test database.

NOTE

Depending on the options you select in steps 2 and 3, different dialog boxes opens in the bottom of the Activity Schedule Information dialog box for entry of additional scheduling data.

8.2.3 Saving an Activity and Saving an Activity as

Follow these steps to save an Activity or to save an Activity with another name.

To save an Activity:

Select **Save** from the File menu on the Activity Definer window.

To save an Activity with a new name:

1. Select **Save As…** from the File menu on the Activity Definer window. The Save Activity As dialog box opens (see Figure 8.2.3-1).
2. Enter the new Activity name.
3. Click **OK** and the Activity is saved with the new name and the Save Activity As dialog box closes.

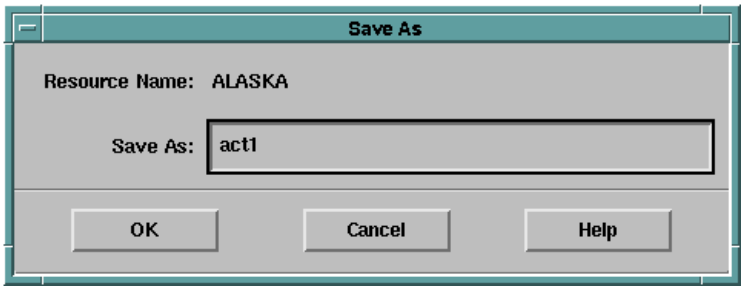


Figure 8.2.3-1. Save Activity As Dialog Box

8.2.4 Closing the Current Activity

When you finish editing one activity and want to begin working on a new one, you should close the current activity definition. Closing clears the window and all dialogs of any existing information. Now the Activity Definer window is ready to define a new activity or modifying an existing one.

To close the current activity definition:

Select **Close** from the File menu of the Activity Definer window.

If you have not done any changes to the activity since you opened it, the activity is closed. The display does not show the activity or the resource name. If you have made changes and not saved them yet, you will see a dialog box that will allow you to save the changes before closing the activity. If you click the Yes button on the dialog box, the changes to the activity will be saved. You may choose not to save the changes.

8.2.5 Deleting an Activity

Authorized users may delete an activity definition no longer required.

To delete an activity:

1. Select **Delete...** from the File menu on the Activity Definer window. The Delete dialog box opens (see Figure 8.2.5-1).
2. Select a Resource Name to filter activities. Activities associated with the selected Resource are displayed in the Activity Names list.
3. Click on the activity to be deleted from the Activity Names list.
4. Click **OK**. The Delete dialog box closes.

   or

   Click **Apply** to accept delete information entered and leave the dialog box open for editing.

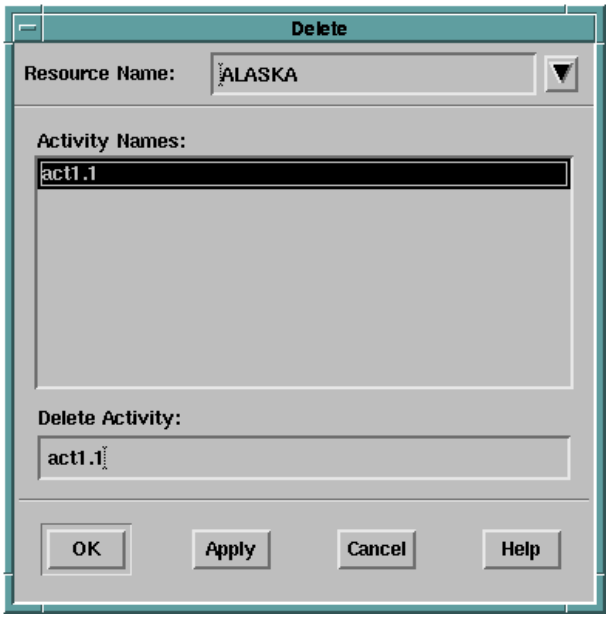


Figure 8.2.5-1. Delete Activity Dialog Box

8.2.6 Exiting the Activity Definer

Follow these steps to exit the activity Definer window.

To exit the Activity Definer:

Select **Exit** from the File menu on the Activity Definer window. The Activity Definer window closes.

8.3 Defining and Understanding Baseline Activity Profiles

A BAP provides a convenient way for you to schedule a set of activities repeatedly on a resource. It will tremendously help in improving your operations efficiency if you familiarize yourself with the concept of BAPs and their use in routine activity scheduling. The BAP definer's purpose is to create an entity that easily schedules many activity definitions at once. A BAP contains multiple activity definitions. When you add an activity definition to the BAP, you must also enter scheduling information for the activity. When scheduling a BAP, you actually tell the software to schedule each individual activity definition contained in the BAP using the scheduling information you provided when creating the BAP. The scheduling information specifies how to determine the start times of the activities based on the reference time, start time and frequency. The activity is scheduled only if the current wall-clock time is later than the reference time. The start times are determined as follows: the first instance of the activity is scheduled at the start time specified for the activity in the BAP; the subsequent instances are scheduled by adding the time period specified in the frequency field to the start time of the previous instance.

There are two ways a BAP can be scheduled. You can schedule a BAP through the General Scheduler. Or you can either install a BAP through the BAP Definer. Installing a BAP is another way to schedule activities in the BAP automatically by the schedule adjuster tool. Each BAP has its own BAP installation time. The schedule adjuster tool schedules activities in a BAP only if the current wall-clock time when the scheduler adjuster is running is equal to or later than the BAP installation time. All activities in the BAP are scheduled repeatedly based on their reference time and frequency. The repetition of activities is terminated by either i) lack of FDD data, or ii) from the installation of a BAP with a later installation time. As new FDD products are brought into the Planning and Scheduling system, all BAPs installed during this period are rescheduled and extended.

The BAP Definer allows authorized users to specify activities in the BAP, their reference times, and individual parameters. Additionally, you can specify scheduling information associated with each activity such as the start time based on an event time and frequency at which it should be scheduled. The BAP Definer will automatically attach a version number to the BAP name when the BAP is saved. This version number will automatically be incremented by one each time the BAP is saved.

Authorized users may delete a BAP definition no longer required. Remember that any modifications to BAPs, including creating new BAPs, and deleting existing ones, done using the BAP Definer tool modify the test database. You must follow procedures set up by the Configuration Control Board to update the Project database from the test database. Refer to Section 8.1.1.

8.3.1 Defining a BAP

To start the BAP Definer:

1. From the Control window, click **Tools...** to open the Tools dialog box. The Tools dialog box opens up.
2. To filter the Scheduling tools only, Select **Planning and Scheduling** from the Tool Type option menu.
3. Select **BAP Definer** from the list of Planning and Scheduling tools.
4. Click **OK**.

   The Tools dialog box closes and the BAP Definer starts up.

8.3.1.1 Creating a BAP

To create a new BAP, you must specify a new BAP name and an associated resource (scheduling component) name. Baseline activity profiles are tied to a resource and you must select one. Only activity definitions created on the same resource are allowed into a BAP. Figure 8.3.1.1-1 is the BAP Definer window used to create new baseline activity profiles.

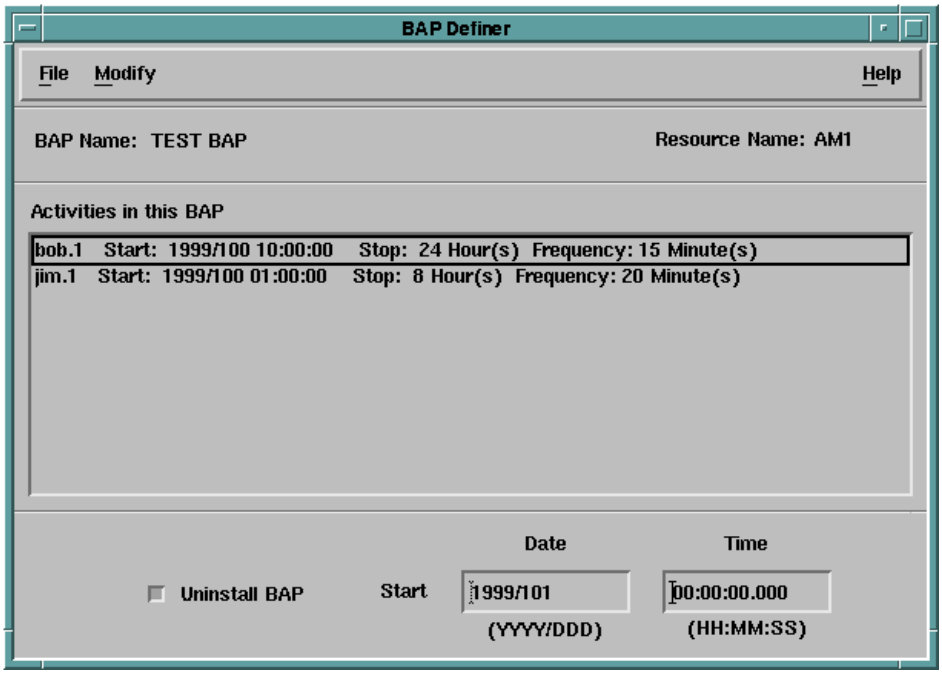


Figure 8.3.1.1-1. BAP Definer Window

To create a new BAP:

1. Select **New...** from the File menu on the BAP definer window. The New BAP dialog box opens (see Figure 8.3.1.1-2).

2. Enter a new BAP name in the text field.
3. Select a resource name.
4. Click **OK**.

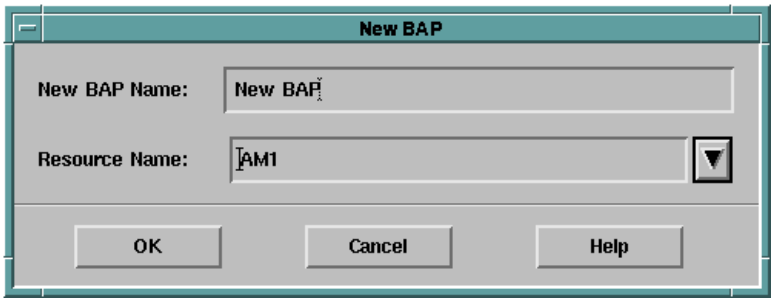


Figure 8.3.1.1-2. New BAP Dialog Box

8.3.1.2 Modifying a BAP

To modify a BAP you must first open it, make any required changes, and then save the BAP. To modify a BAP, you must be authorized to make modifications to existing BAPs. You can change the activity definitions within the BAP, as well as modify the activity's scheduling information and command parameters.

8.3.1.2.1 Open a BAP

To modify a BAP, you must either create a new BAP or open an existing one. Once a BAP is displayed on the BAP Definer tool, you may modify it using options available from the "Modify" menu. Figure 8.3.1.2.1-1 illustrates the open BAP dialog box where you may open an existing BAP.

To open a BAP:

1. Select **Open…** from the File menu on the BAP Definer window.
2. Select the resource name to filter baseline activity profiles.
3. Select a BAP.
4. Click **OK** and the Open BAP dialog box closes. The BAP name and the resource name opens in the BAP Definer window.

   or

   Click **Apply** to accept the BAP information entered and leave the Open dialog box open for editing.

8.3.1.2.2 Modify Activities in a BAP

The activities dialog box allows you to add, Remove, or replace activities to/from a BAP.

To modify activities in a BAP:

1. Select **Activity List…** from the Modify menu on the BAP definer window. The Activity List dialog box opens (see Figure 8.3.1.2.2-1).
2. Click on the desired activity from the Available Activities list.

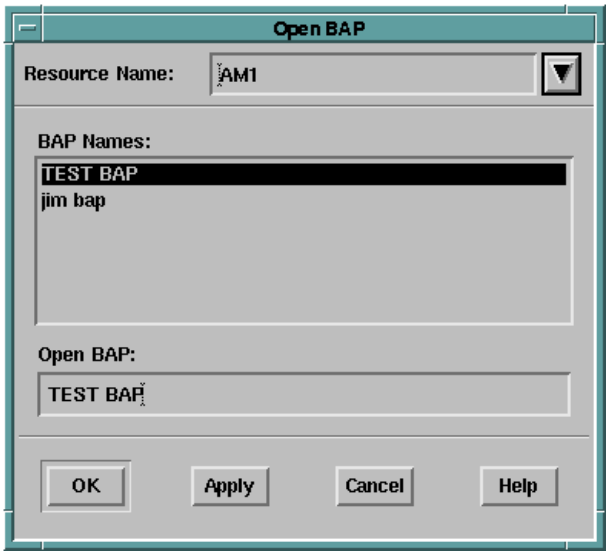


Figure 8.3.1.2.1-1. Open BAP Dialog Box

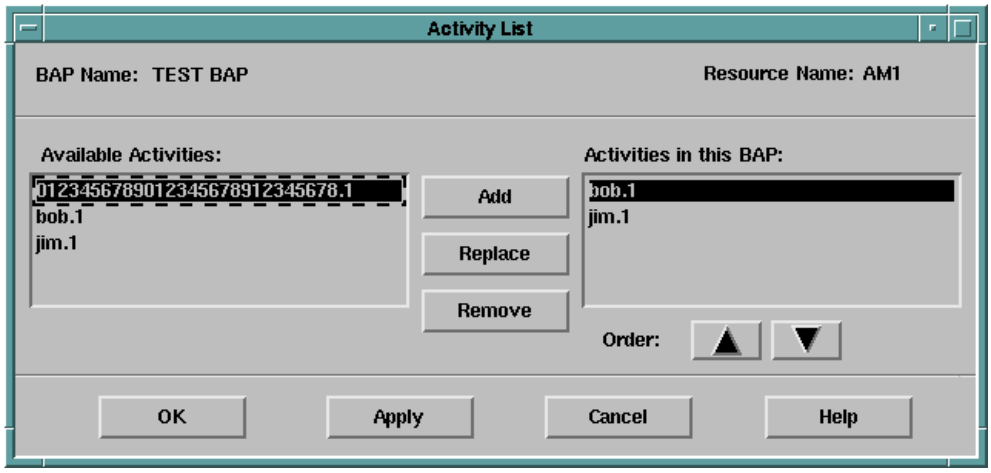


Figure 8.3.1.2.2-1. Activity List Dialog Box

3. Click **Add**.

   The added activity appears in the "activities in this BAP" list. These steps are repeated for all activities to be included in the BAP.

4. Click **OK** and the Activity List dialog box closes. The revised activities opens in the BAP Definer window.

   or

   Click **Apply** to accept the BAP information entered and leave the dialog box open for more modifications.

Optional procedure for deleting an existing activity:

1. Click on an activity in the "Activities in this BAP" list.
2. Click **Remove**.
3. Click **OK** to close the Activity List dialog box. The revised activities open in the BAP Definer window.

   or

   Click **Apply** to accept the BAP information entered and leave the dialog box open for more modifications.

Optional procedure for replacing an existing activity:

1. Click on an activity in the "Available Activities" list.
2. Click on an activity in the "Activities in this BAP" list.
3. Click **Replace** and the activity will be replaced.
4. Click **OK** and the Activity list dialog box closes. The revised activities opens in the BAP definer window.

   or

   Click on **Apply** to accept the BAP information entered and leave the dialog box open for more modifications.

8.3.1.2.3 Modify Command Parameters

The command parameters dialog box allows you to modify command parameters for each command within an activity.

To modify command parameters:

1. Select **Command Parameters…** from the Modify menu of the BAP Definer window. The Parameters dialog box opens (see Figure 8.3.1.2.3-1).

2. Click on the desired activity in the “Activities in the BAP” list.
3. Click on the desired command from the “Commands” list.
4. Click on a parameter from the “Parameters” list.
5. Modify any parameter values.
6. Click **Apply** and repeat until done.
7. Click **OK** and the parameters dialog box closes.

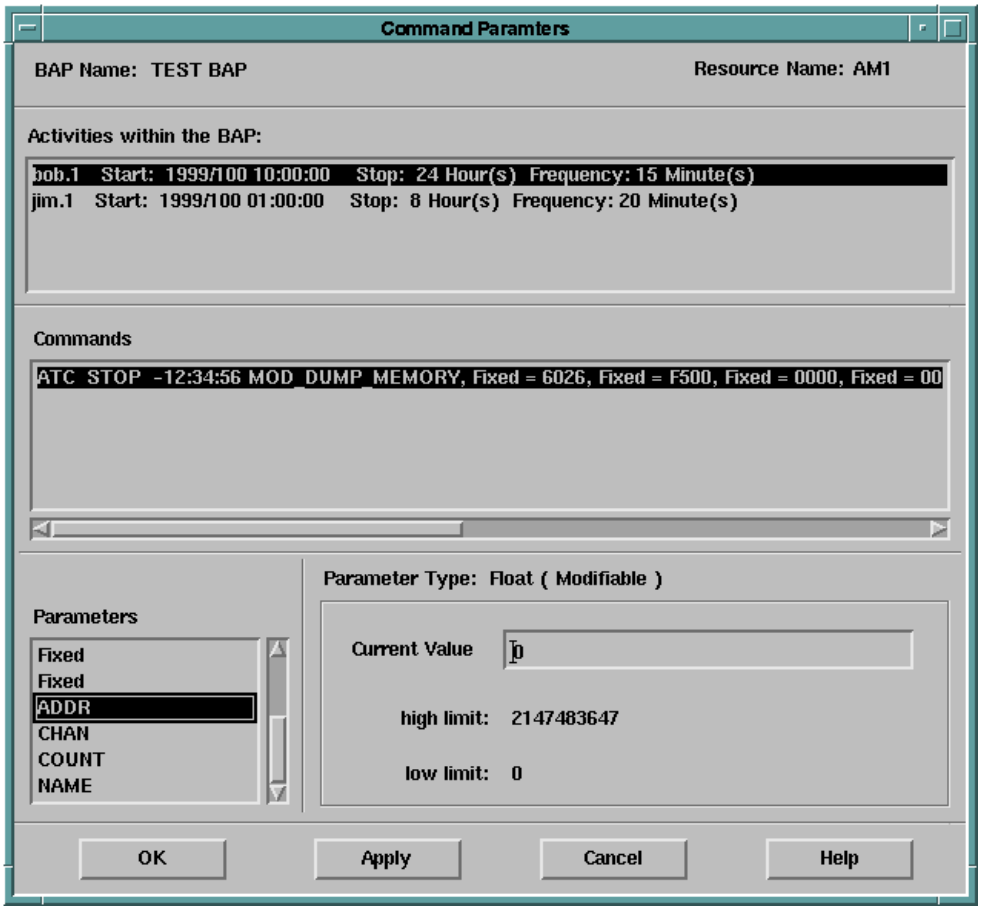


Figure 8.3.1.2.3-1. Parameters Dialog Box

8.3.1.2.4 Modify Activity Scheduling Information

The scheduling information dialog box allows you to add scheduling information for each activity within a BAP. Scheduling information determines when activities within the BAP are scheduled. Activity definitions within the BAP can have a reference time. This reference time, along with the frequency, is used to calculate when to schedule activity. The start of an activity may be specified based on an absolute time or an event.

To edit activity scheduling information:

1. Select **Scheduling Info…** from the Modify menu of the BAP Definer window. The Scheduling Information dialog box opens (see Figure 8.3.1.2.4-1).
2. Select **Start Time** or **Start Event**.
3. Select **Stop Time, Stop Event,** or **Duration**.
4. Enter the origination date and time.

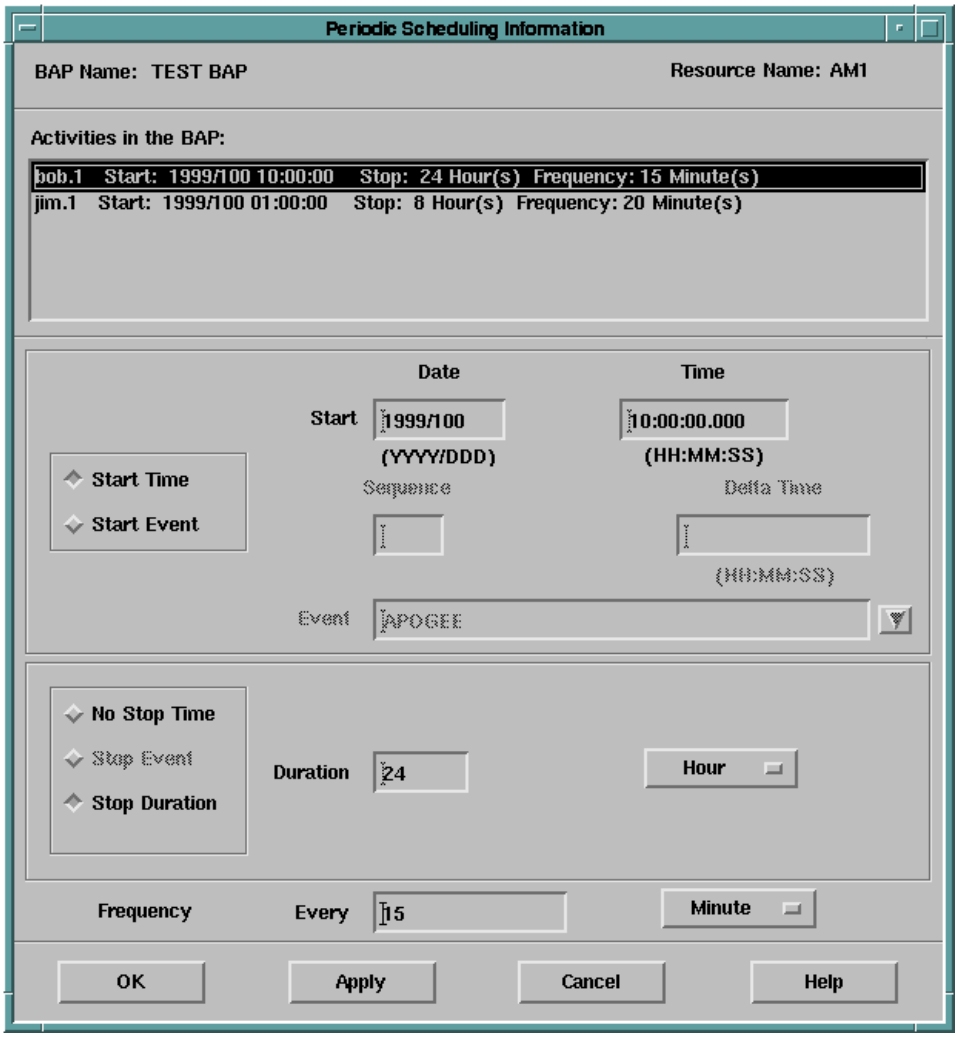


Figure 8.3.1.2.4-1. Scheduling Information Dialog Box

5. Enter the date in the format of YYYY/DDD if you selected “Start Time” and/or “Stop Time.”
6. Enter the time in the format of HH:MM:SS if you selected “Start Time” and/or “Stop Time.”

7. Enter the orbit number if you selected “Start Event” and/or Stop Event.”
8. Enter the sequence number if you selected “Start Event” and/or “Stop Event.”
9. Select an event if you selected “Start Event” and/or “Stop Event.”
10. Enter the Delta Time in the format of HH:MM:SS if you selected “Start Event” and/or “Stop Event.”
11. Enter the Duration if you selected “Duration” as a stop time.
12. Select a Unit for the duration if you selected “Duration” as a stop time.
13. Enter the “Frequency” to determine the periodicity of the activity.
14. Select the Frequency unit.
15. Click **Apply** and repeat until done.
16. Click **OK** and the scheduling information dialog box closes.

8.3.1.3 Saving a BAP and Saving a BAP as

Follow these steps to save a BAP or to save a BAP with another name.

To save a BAP:

Select **Save** from the File menu on the BAP Definer window.

To save a BAP with a new name:

1. Select **Save As…** from the File menu on the BAP Definer window. The Save BAP As dialog box opens (see Figure 8.3.1.4-1).
2. Enter the new BAP name.
3. Click **OK** and the BAP is saved with the new name and the Save BAP As dialog box closes.

8.3.1.4 Closing a BAP

When you finish editing one BAP and want to begin working on a new one, you should close the current BAP. Closing clears the window and all dialogs of any existing information. Now the BAP Definer window is ready to define a new BAP or modifying an existing one.

To close a BAP:

Select **Close** from the File menu on the BAP Definer window.

If you have not done any changes to the BAP since you opened it, the BAP is closed. The display does not show the BAP or the resource name. If you have made changes and not saved them yet, you will see a dialog box that will allow you to save the changes before closing the BAP. If you click the **Yes** button on the dialog box, the changes to the BAP will be saved. You may choose not to save the changes.

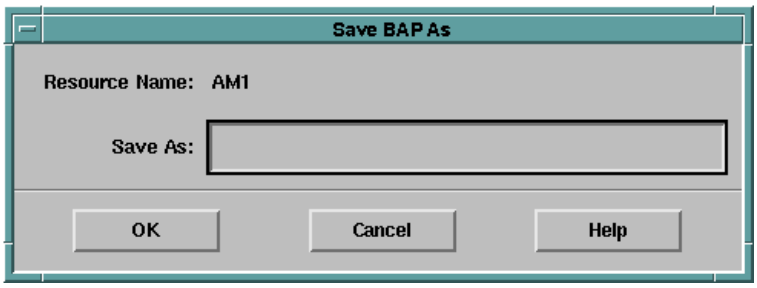


Figure 8.3.1.4-1. Save As BAP Dialog Box

8.3.1.5 Deleting a BAP

The system allows authorized users to delete BAPs. Deleting a BAP does not affect anything already scheduled because the software does not maintain a relationship between the BAP and its activities once scheduled.

To delete a BAP:

1. Select **Delete…** from the File menu on the BAP Definer window. The Delete BAP dialog box opens (see Figure 8.3.1.5-1).
2. Select a "Resource Name" to filter the baseline activity profiles.
3. Select the desired BAP from the list.
4. Click **OK**. The BAP is deleted and the Delete BAP window closes, or, click **Apply** to accept the "Resource Name" and associated BAP Names entered and leave the dialog box open for editing.

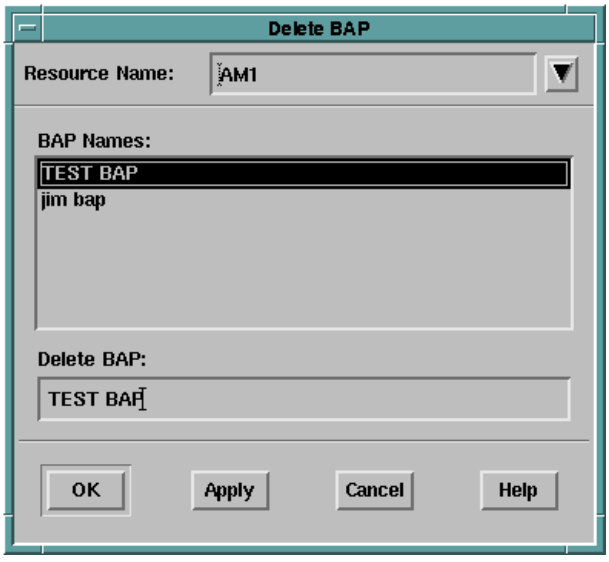


Figure 8.3.1.5-1. Delete BAP Dialog Box

8.3.1.6 Exiting the BAP Definer

To exit the BAP Definer:

Select **Exit** from the File menu on the BAP Definer window.

8.3.2 Scheduling a BAP

There are two ways to schedule a baseline activity profile. You can either install one through the BAP definer, or schedule one through the General Scheduler.

8.3.2.1 Installing a BAP

To install a BAP, click the install button and enter a date and time on the BAP Definer window. Once the BAP has been installed, scheduling occurs automatically. When the planning and scheduling software receives FDD data, activities are rescheduled with updated FDD data. When a BAP is installed through this time period, it will automatically be scheduled or extended if previously scheduled.

Installing a BAP has the advantage of it being "extended" when new FDD data is ingested. That is, when new FDD data is loaded into the planning and scheduling system the installed BAPs will be scheduled from their install date (provided it is not past current time) to either the next installed BAP or the end of FDD data. Once a BAP is installed (and it is the last one installed), its activities will continue to be scheduled as new FDD data arrives. If an activity was scheduled before a BAP was extended, the activity would remain on the schedule and the BAP would be extended "around" this activity. Therefore, if you schedule many activities into the future and then install a BAP on the same resource, these activities would remain when the BAP is extended over their scheduled period. The install method of scheduling a BAP follows the non-impact without over subscription mode which is discussed below.

8.3.2.2 Scheduling through the General Scheduler

The second way to schedule BAPs is through the General Scheduler. After providing a start and stop time for the BAP and pressing the schedule button, the BAP will be scheduled for the selected time range and that time range only. If FDD data does not exist for the time period requested, activities requiring the FDD data will not be scheduled.

When you schedule a BAP through the General Scheduler, scheduled start and stop times are needed. But you also need to know what type of scheduling you want to perform. The General Scheduler has three modes: impact, non-impact without over subscription, and non-impact with over subscription. Basically, impact scheduling removes any activity that is on the schedule at the time of the schedule request and places the new activity in its place. Non-impact scheduling without over subscription will only schedule an activity when nothing has been scheduled over the same time range. Non-impact scheduling with over subscription will schedule the activity regardless of whether an activity was already scheduled for the same time. It will not remove the previously scheduled activities. Both activities will exist on the schedule sharing the same time. It is recommended that you install BAPs for routine operations activities that do not require frequent attention; however, use of any of the above two methods is fine as long as you understand all implications.

8.4 Using Constraints

Constraints are categorized into two types: Activity-level constrains, and Command-level constraint. Activity-level constraints are defined as constraints between two activities defined in the P&S data base. Command-level constraints are defined as constraints between spacecraft commands. The Constraint Definer creates Activity-level constraints for use in the Planning and Scheduling system.

A Constraint is a rule indicating when a scheduled activity or mode should or should not occur in conjunction with an event or with some other scheduled activity or mode. For example, activity A1 on resource R1 might require resource R2 to be in mode M1 in order to work properly. Therefore, you would want the rule:

R1 activity A1 should be during R2 mode M1

Perhaps there is a time delay involved because activity A1 on resource R1 will not work properly unless resource R3 has not been in mode M2 for at least an hour. Therefore, you would want the rule:

R1 activity A1 should not start within 1:00:00 after R3 mode M2

Given these rules, you may be properly informed when scheduling an activity if there is a conflict, or whether some other activity needs to be scheduled in conjunction with it.

8.4.1 How Constraints Work

8.4.1.1 Left and Right Parts

A constraint contains two parts: The left hand and the right hand parts:

R1 activity A1	should not be during	R3 mode M2
left hand part		right hand part

Each part is described by a resource and a particular activity or mode. In addition, for right hand part, an orbital event associated with that resource may be specified. The constraint defines the temporal relationship (“Should not be during” in this example) between the left hand part and the right hand part.

8.4.1.2 Logging of Violations

A detected violation is logged to the events log when the activity definition is actually scheduled (through one of the scheduling tools) on a given resource. The activity or mode is checked against the list of constraints associated with its resource. If a violation is found, then:

1. If the activity or mode in violation occurs on the left hand of a constraint, the violation is logged on that activity or mode.
2. If it occurs on the right hand of a constraint, the violation is logged on the previously scheduled activity or mode on the left hand of that constraint.

Each scheduled activity contains a list of violations logged. In the Timeline tool, a scheduled activity containing violations is flagged. A user may then interrogate the flagged item to examine the list of violations.

8.4.1.3 Removing Violations

A violation is removed by one of the following means:

1. The activity or mode on which the violation is logged is unscheduled. This removes any violations logged on that activity or mode.
2. An activity or mode occurring on the right hand of a constraint is rescheduled or unscheduled such that the constraint is now satisfied. The violation previously logged on the activity or mode on the left side is then removed.

8.4.1.4 Types of Constraints

There are six different ways to relate the left and right hands of a constraint. In paragraphs 8.4.1.4.1 through 8.4.1.4.6, an activity or mode is indicated by a rectangle on a timeline where the left side of the rectangle represents the Start time and the right side represents the End time.

8.4.1.4.1 During

In a "During" constraint, the left hand should occur during the right hand (see Figure 8.4.1.4.1-1).

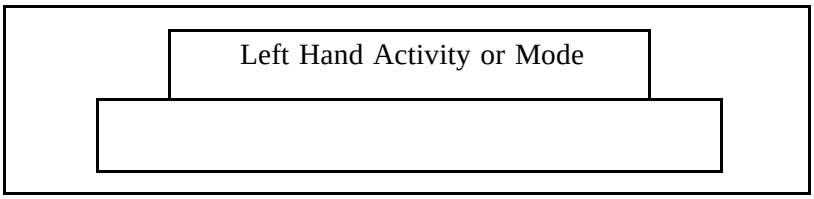


Figure 8.4.1.4.1-1. During Constraint

That is, the left hand should start and finish within the period of the right hand. If not, or if the specified right hand activity, mode or event has not been scheduled, a violation is logged.

8.4.1.4.2 Not During

In a "Not During" constraint, the left hand should not overlap the right hand at all (see Figure 8.4.1.4.2-1). If there is any overlap, a violation is logged.

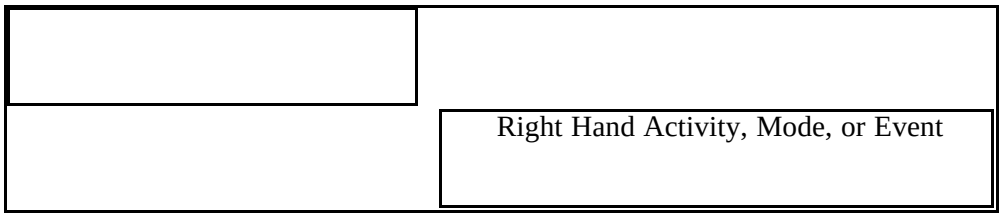


Figure 8.4.1.4.2-1. Not During Constraint

8.4.1.4.3 Before

In a "Before" constraint, the left hand should finish within a certain period before the right hand starts (see Figure 8.4.1.4.3-1). If not, or if the specified right hand activity, mode, or event has not been scheduled, a violation is logged.

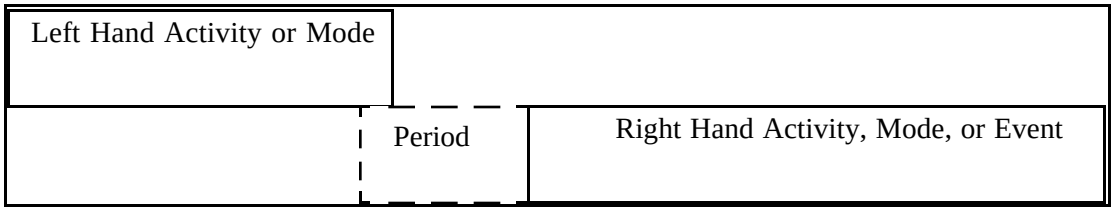


Figure 8.4.1.4.3-1. Before Constraint

8.4.1.4.4 Not Before

In a "Not Before" constraint, the left hand should not finish within a certain period before the right hand (see Figure 8.4.1.4.4-1). The left hand may overlap the period as long as it does not finish within the period. Otherwise, a violation is logged.

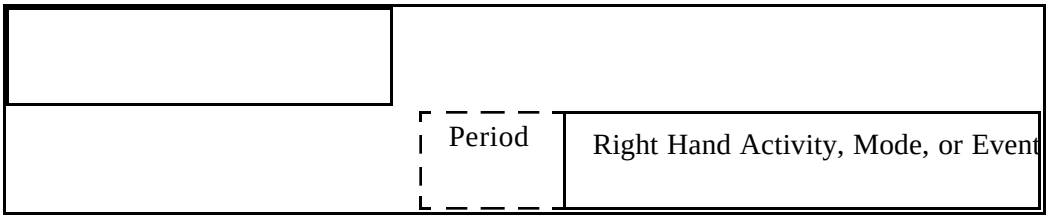


Figure 8.4.1.4.4-1. Not Before Constraint

8.4.1.4.5 After

In an "After" constraint, the left hand should start within a certain period after the right hand ends. (see Figure 8.4.1.4.5-1). If not, or if the specified right hand activity, mode, or event has not been scheduled, a violation is logged.

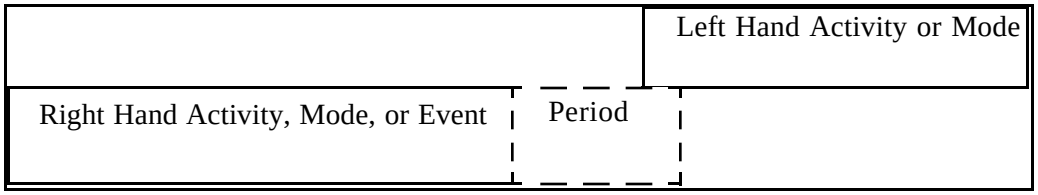


Figure 8.4.1.4.5-1. After Constraint

8.4.1.4.6 Not After

In a "Not After" constraint, the left hand should not start within a certain period after the right hand finishes. (see Figure 8.4.1.4.6-1). The left hand may overlap the period as long as it does not start within the period. Otherwise, a violation is logged.

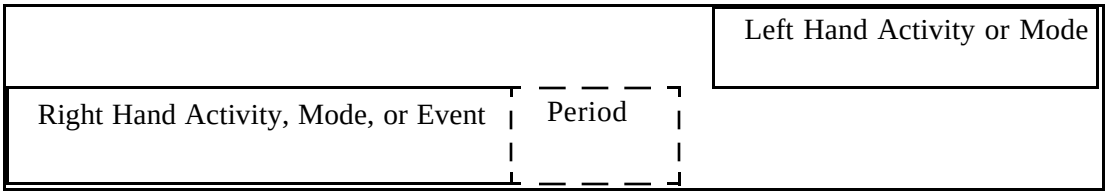


Figure 8.4.1.4.6-1. Not After Constraint

8.4.1.5 Severity of a Constraint

There are two levels of severity in a constraint violation, soft and hard.

8.4.1.5.1 Soft Constraint

A soft constraint is logged but not considered severe enough to prevent generation of a DAS by the P&S tools. This type of constraint uses the word "should" in its definition:

R1 activity A1 should be during R2 mode M1

8.4.1.5.2 Hard Constraint

A hard constraint is considered severe enough to prevent generation of a DAS by the P&S tools. This type of constraint uses the word "must" in its definition:

R1 activity A1 must be during R2 mode M1

Hard constraint violations will prevent the successful generation of ATC loads (refer to paragraph 8.9.1 for more information concerning constraint violation checking and handling). You must remove all hard constraints on a plan before generating an ATC load.

8.4.2 Defining a Constraint

The Constraint Definer allows authorized users to create constraints as described above.

Authorized users may delete a Constraint definition no longer required. Remember that any modifications to Constraints, including creating new Constraints and deleting existing ones, done using the Constraint Definer tool modify the test database. You must follow procedures set up by the Configuration Control Board to update the Project database from the test database. Refer to section 8.1.1. The Constraint Definer will automatically attach a version number to the constraint name when the constraint is saved. This version number will automatically be incremented by one each time the constraint is saved.

To start the Constraint Definer:

1. Click **Tools...** on the Control window. The Tools dialog box opens up.
2. To filter the Scheduling tools only, Select **Planning and Scheduling** from the Tool Type option menu.
3. Select **Constraint Definer** from the list of Planning and Scheduling tools.
4. Click **OK**. The Tools dialog box closes and the Constraint Definer starts up.

8.4.2.1 Creating a Constraint

To create a new constraint, you must specify a new constraint name. Figure 8.4.2.1-1 shows the Constraint Definer main window when it comes up. The window shows the widgets with values obtained from the constraint definition; you can modify the values as follows.

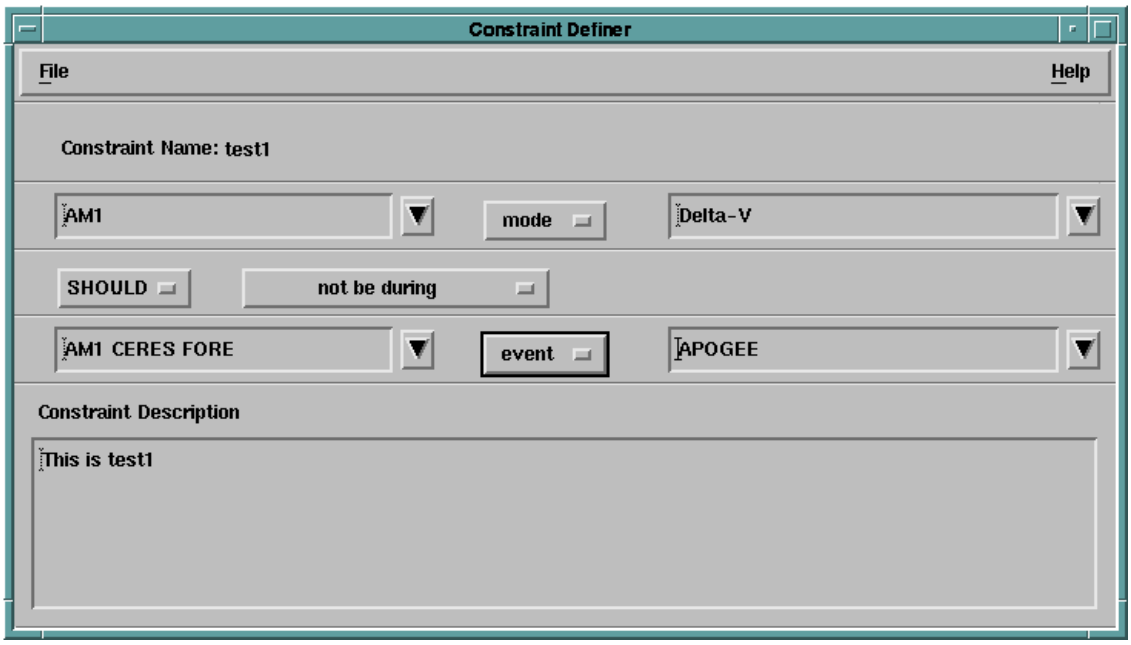


Figure 8.4.2.1-1. Constraint Definer Main Window

To create a new Constraint:

1. Select **New…** from the File menu on the Constraint definer window. The New Constraint dialog box opens (see Figure 8.4.2.1-2).
2. Enter a new Constraint name in the text field.
3. Click **OK**.

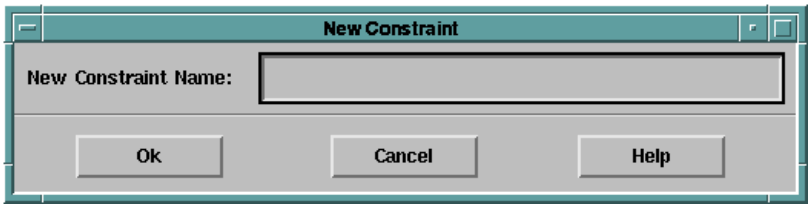


Figure 8.4.2.1-2. New Constraint Dialog Box

8.4.2.1.1 Open a constraint

Figure 8.4.2.2-1 illustrates the open constraint dialog box where you may open an existing constraint.

To open a constraint:

1. Select **Open…** from the File menu on the constraint Definer window.
2. Select the left resource name to filter from the available list of constraints.
3. If you know the constraint that you want to modify, select activity or mode associated with the constraint, on this resource.
4. Repeat steps 2 and 3 for the right resource.
5. Click on the "Filter Now" button.
6. Select a constraint from the filtered list of constraints.
7. Click **OK** and the Open constraint dialog box closes. The constraint name shows on top of the constraint Definer window.

   or

   Click **Apply** to accept the constraint information entered and leave the Open dialog box open for editing.

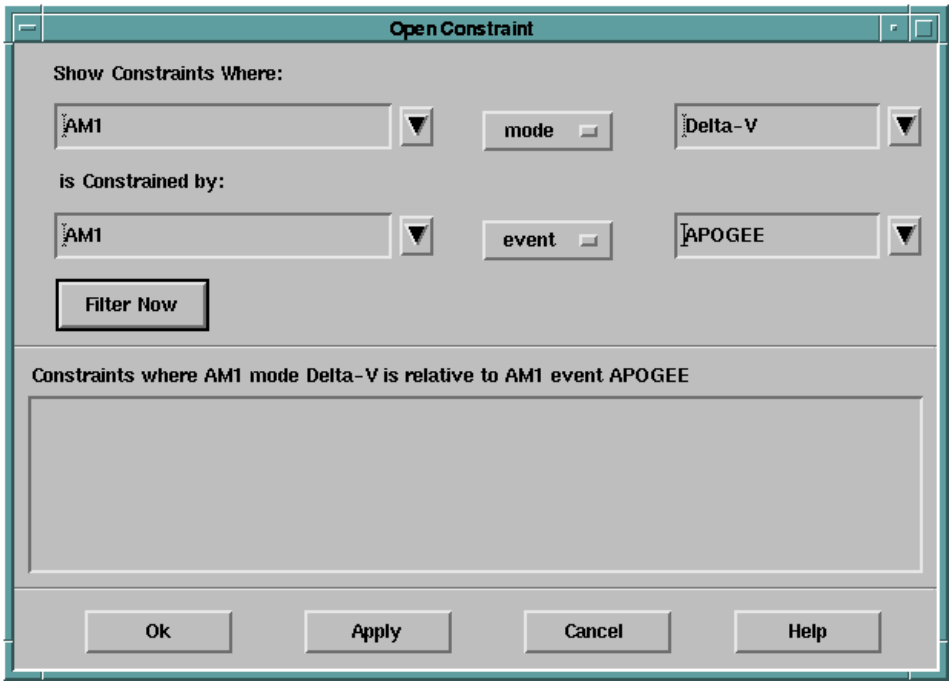


Figure 8.4.2.2-1. Open Constraint Dialog Box

8.4.2.2 Modifying a Constraint

To modify a constraint, you must be authorized to make modifications to existing constraints. Once a constraint is displayed on the constraint Definer tool, you may modify the left or right parts

as well as the temporal relation between them by clicking on the pop-up menus and selecting the desired option (see Figure 8.4.2.1-1). The window shows the widgets with values obtained from the constraint definition; you can modify the values as follows.

To modify a constraint:

1. If you want to change the left part of the constraint, select **activity** or **mode** associated with the left part which is the top row of widgets.
2. From the list of activities or modes depending on your selection, select your desired activity or mode.
3. If you want to change the right part of the constraint, select **activity, mode,** or **event** associated with the right part which is the third row of widgets.
4. From the list of activities, modes, or events depending on your selection, select your desired activity, mode, or event.
5. Set the value of the first button in the second row of widgets to **Should** if you want Soft constraint; set the value to **Must** if you want a Hard constraint.
6. If you want to change the temporal relation, select the second widget in the second row of widgets.
7. If you have chosen one of **Before, After, Not Before, or Not After** relation, you can specify the time period in the text widget that appears to the right.
8. Update the description of the constraint in the text field at the bottom.
9. Select the **Save** option under the **File** menu.

8.4.2.3 Saving a Constraint and Saving a Constraint as

Follow these steps to save a constraint or to save a constraint with another name.

To save a constraint:

Select **Save** from the File menu on the constraint Definer window.

To save a constraint with a new name:

1. Select **Save As…** from the **File** menu on the constraint definer window. The **Save constraint As** dialog box opens (see Figure 8.4.2.4-1).
2. Enter the new constraint name.
3. Click **OK** and the constraint is saved with the new name and the Save constraint As dialog box closes.

Figure 8.4.2.4-1. Save As Constraint Dialog Box

8.4.2.4 Closing a constraint

When you finish editing one constraint and want to begin working on a new one, you should close the current constraint. Closing clears the window and all dialogs of any existing information. Now the constraint Definer window is ready to define a new constraint or modifying an existing one.

To close a constraint:

Select **Close** from the File menu on the Constraint Definer window.

If you have not done any changes to the constraint since you opened it, the constraint is closed. The display does not show the constraint or the resource name. If you have made changes and not saved them yet, you will see a dialog box that will allow you to save the changes before closing the constraint. If you click the Yes button on the dialog box, the changes to the constraint will be saved. You may choose not to save the changes.

8.4.2.5 Deleting a constraint

The system allows authorized users to delete constraints. Deleting a constraint does not affect anything already scheduled.

To delete a constraint:

1. Select **Delete...** from the **File** menu on the constraint Definer window. The Delete constraint dialog box opens (see Figure 8.4.2.5-1).
2. If you know the constraint that you want to delete, select activity or mode associated with the constraint, on this resource.
3. Repeat steps 2 and 3 for the right resource.
4. Click on the "**Filter Now**" button.
5. Select the desired constraint from the list.
6. Click **OK**. The selected constraint is deleted and the Delete constraint window closes, or, click **Apply** to delete the selected constraint and leave the dialog box open for editing.

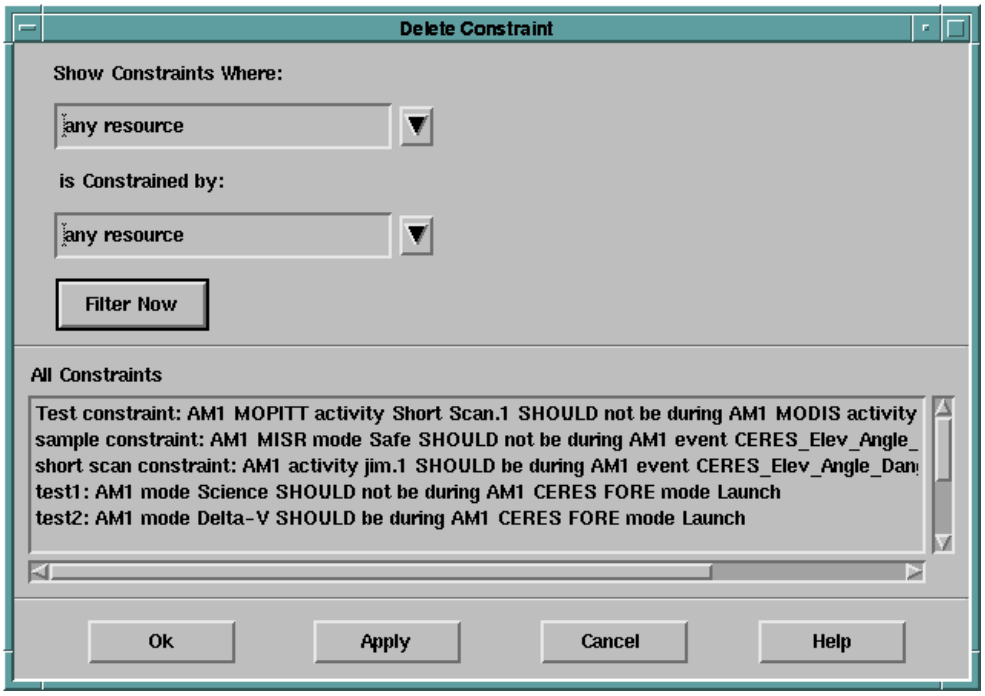


Figure 8.4.2.5-1. Delete constraint Dialog Box

8.4.2.6 Exiting the Constraint Definer

To exit the constraint Definer:

Select **Exit** from the **File** menu on the Constraint Definer window.

8.5 Timeline tool: Working With Plans

In order to perform scheduling or just view schedules in the system, you need to work with plans. Plans are a collection of activities allocated to resources over time. Two basic types of plans exist, Master Plans, and What-if Plans. There is and always will be a single Master Plan. This is the plan from which both the ATC load and Ground Schedule are generated. At any given time there can be zero to several of What-if Plans existing in the system created by the FOT and IOTs.

Typically, you will do most of your work directly on the Master Plan and only use What-if Plans when you want to analyze or experiment with a scenario, possibly to see how many constraints may arise, or how much a data or power buffer will fill as a result of scheduling various activities. You must always coordinate the updates to the Master Plan with the FOT in the EOC.

To schedule an activity or a BAP on a plan, you need to use the Timeline to open plan for a period which at least covers the time of activities that you want to schedule. Then use the General Scheduler tool to select the plan and to schedule activities or BAPs. Remember that you can schedule activities or BAPs on a plan using the General Scheduler only after you opened that plan using the Timeline.

8.5.1 Displaying Plans with the Timeline Tool

The Timeline Tool (see Figure 8.5.1-1) is a graphical representation of activities scheduled on, and the state of, resources modeled within EOS for planning and scheduling.

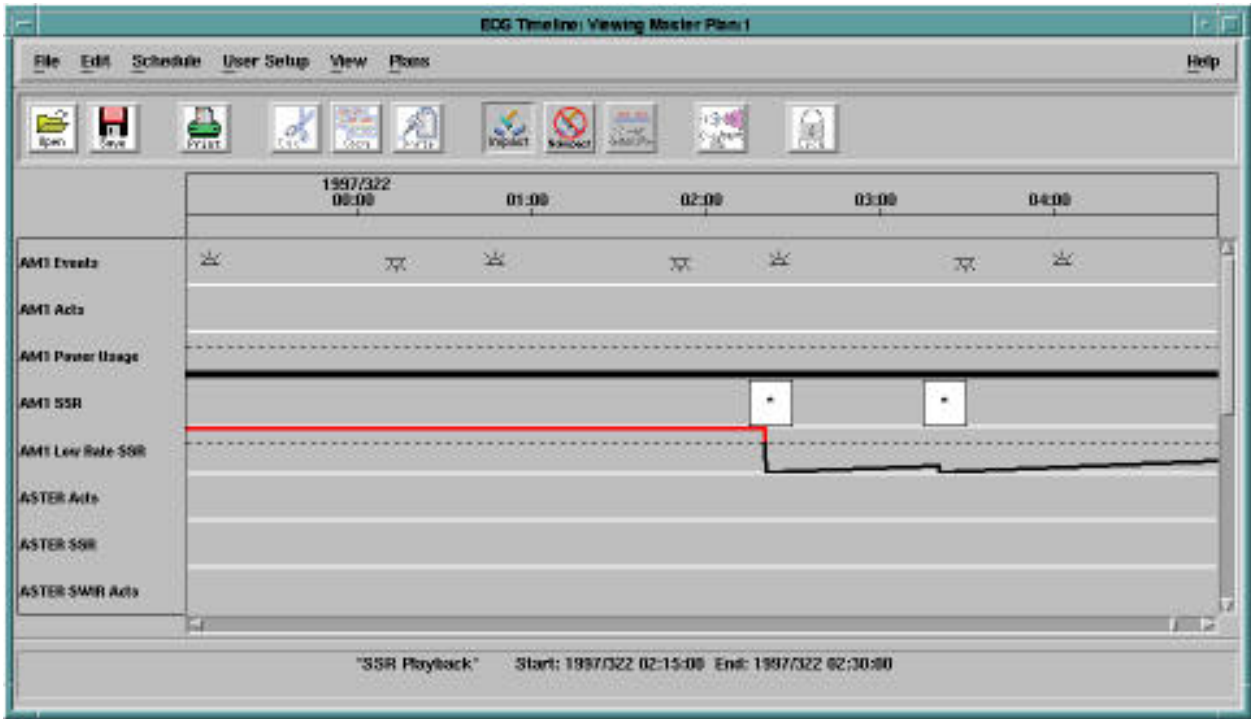


Figure 8.5.1-1. Timeline Tool

The Timeline display consists of six main regions:

Menu Bar (top).

Tool Bar (below the Menu Bar).

Resource Display Region (center graphical display).

Resource Scroll Bar (right side).

Time Scroll Bar (bottom).

Status Bar (bottom, under Time Scroll Bar).

1. The Menu Bar consists of: the File menu for manipulating plans; the Edit menu for modifying scheduled activities; the Schedule menu for selecting scheduling options; the User Setup menu for modifying the Timeline's configuration; the View menu for manipulating the time and subregions; and the Plans menu for switching the Timeline between opened plans.

2. The Tool Bar contains buttons/shortcuts for frequently used commands within the timeline. These shortcuts include **Open** and **Save** for plan manipulation, and **Cut**, **Copy**, **Paste**, and scheduling options for activity modifications.

3. The Resource Display Region displays a subregion for each configured resource. Orbit events are displayed on one or more lines for spacecraft resources. The Resource Display Region also displays a label for each line on the left and the currently displayed time at the top.

4. The Resource scrollbar is used to scroll through the list of displayed resources. The number of resources displayed may be changed by selecting the number under the View menu on the Main Menu Bar. Doing so will modify the size of each line in the Resource Display Region to display the correct number of resources in the available window space.

5. The Time Scrollbar is used to scroll through time over the duration of an opened plan. The length of time being displayed may be changed by selecting a different duration of time to display under View menu on the Main Menu Bar.

6. The Status Bar located at the bottom of the Timeline window beneath the Time Scroll Bar provides detailed information about the Resource Display Region of the Timeline. By moving the mouse over any activity or event, information such as the absolute start and stop times about that activity or event will be displayed in the Status Bar. For consumable resources such as power, the percentage used is displayed.

To start the Timeline:

1. Click **Tools...** on the Control window. The Tools dialog box opens up.
2. To filter the Scheduling tools only, Select **Planning and Scheduling** from the Tool Type option menu.
3. Select **Timeline** from the list of Planning and Scheduling tools.
4. Click **OK**. The Tools dialog box closes and the Timeline starts up.

8.5.2 Opening Plans

In order to display a plan, it must be opened (just like opening a document in a word processing application). All plans created by either the FOT or an IOT can be viewed by any user in the system. This does not mean that any user can modify them.

To open an existing plan:

1. Choose **Open…** from the File pulldown on the Timeline or click **Open** on the tool bar. An Open Plan dialog box opens (see Figure 8.5.2-1).
2. On the Open Plan dialog box, select the plan you wish to open.
3. Enter the time duration in format YYYY/DDD HH:MM:SS.

Both a start and a stop time must be entered in order to open the plan. Remember that you can specify dates in one of the three formats: DayOfYear, MonthDayYear, and DayMonthYear. The Timelline displays dates appropriately according to the format that you have selected. You need to enter dates conforming to the format that you have selected. Otherwise, an error will be reported. The following discussion assumes the DayOfYear format.

4. Click **OK** on the Open Plan dialog box. The Open Plan dialog box closes and the plan is displayed on the Timeline.

A plan may be selected by typing the name of the plan into the plan Selection field, or by clicking its name in the list of available plans in the Open Plan list. If the name is typed, the name entered must match one of the names in the list of available plans. A plan may be opened as many times as necessary. This is particularly helpful when two separate time ranges of the same plan are wanted for viewing. Also, you may open more than one plan for a different time period, following the same procedure. When a plan is opened it becomes the active plan and is displayed by the Timeline.

It is recommended that you open a plan only for the period of time necessary and no more. There are several reasons for this. One, the larger the time span, the more time it takes to load and save the plan from the database. Two, more information is pulled into your computers memory slowing down processing. And three, because of the distributed nature of plan modifications, local information will be updated every time others save the same plan over the same time period.

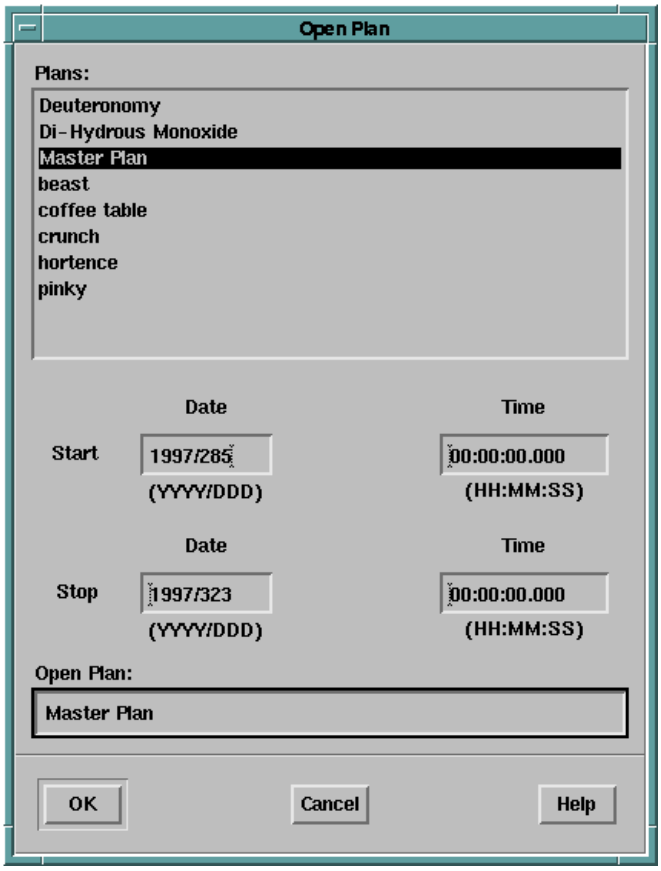


Figure 8.5.2-1. Open Plan Dialog Box

8.5.3 Closing Plans

It is recommended that a plan be closed if it is no longer needed. Because of the distributed nature of plan modifications, local information will be updated every time others save the same plan over the same time period.

To close a plan:

1. Select the plan that you want to close.
2. Choose **Close** under the File menu on the main window of the Timeline. A dialog box opens prompting you if you want to save any changes made to the plan.
3. Click **Yes** to save the plan, **No** to not save the plan, or **Cancel** to cancel the closing of the plan.

   If **Yes** or **No** is selected on the Save dialog box, the plan will be closed and the Timeline will either revert to another open plan; or, if no plans are open, no plan will be displayed.

8.5.4 Toggling Between Different Plans

The Timeline is able to open more than one plan at a time. This provides the capability to perform comparisons between plans. You can also cut and paste scheduled activities between plans.

To switch to another open plan:

When a plan is opened it becomes the active plan and is displayed by the Timeline. To work with another open plan on the Timeline, that plan must become the active plan.

To select an active plan:

Choose the name of the plan to work on from the Plans menu. The selected plan becomes the active plan, and activities scheduled on the plan are displayed by the Timeline.

8.5.5 Creating What-If Plans

There may be times when you need to experiment with different planning scenarios without affecting the Master Plan. In situations like this you can create a What-if Plan. Like a word processing application, creating a What-if Plan using the Timeline places a temporary plan in memory until you save the What-if Plan. After you create a new plan you can schedule activities or BAPs on it or copy and paste activities from open portion of any other plan. By saving a What-if Plan, you commit any activities allocated to resources to the database for later retrieval under the What-if Plan name.

To create your own What-if Plan:

1. Choose **New…** from the File menu. The New Plan dialog box opens (see Figure 8.5.5-1).
2. Enter the name of the new plan and the time range you want to have this plan open for.
3. Click **OK**. The New Plan dialog box closes and the Timeline displays the new plan.

Since there is only one Master Plan, you can only create What-if Plans. Also, you must create a unique name for a new What-if Plan. The software does not allow for duplicate plan names.

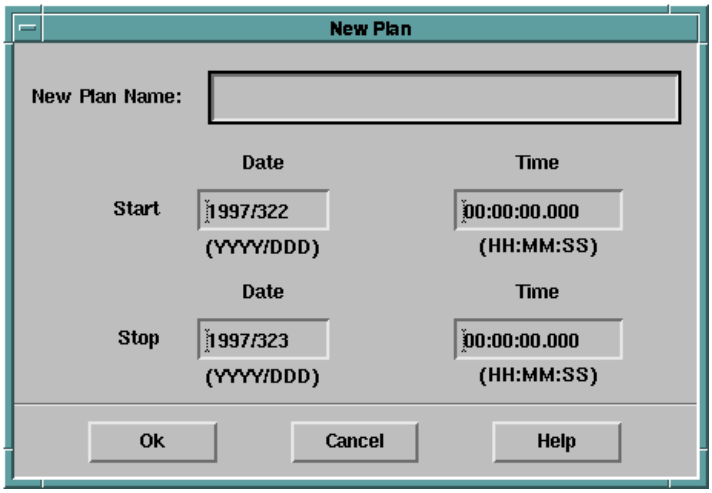


Figure 8.5.5-1. New Plan Dialog Box

8.5.6 Saving Plans

When you open a plan you create a temporary copy of the plan in memory. Modifications can be made to this plan without affecting the actual plan stored in the database until you execute a save. Performing a save on a plan saves all scheduled activities on that plan to the database and distributes changes to other users in the system.

To save a plan:

Choose **Save** under the File pulldown menu or click **Save** on the Timeline's tool bar.

NOTE

Once you have saved a plan it is impossible to revert to an older version; therefore, you should make sure you wish to commit the changes to the database before saving. If you want to be able to revert to an older version of the plan, first save it under a different name that you can open later.

To save a plan as another plan (Save As):

1. Choose **Save As…** under the File menu. A Save As dialog box opens (see Figure 8.5.6-1).
2. Type the name of the plan into which you wish to save the currently active plan.
3. Click **OK**. The plan will be saved under the new name and the Timeline will display the new plan as the current active plan.

You cannot save any plan under the name “Master Plan”. Because of this, the only way you can get changes made on a What-if Plan onto the Master Plan is by copying and pasting scheduled activities between those plans. You can only save plans under the same name of an existing What-if Plan if you are the owner of the existing What-if Plan.

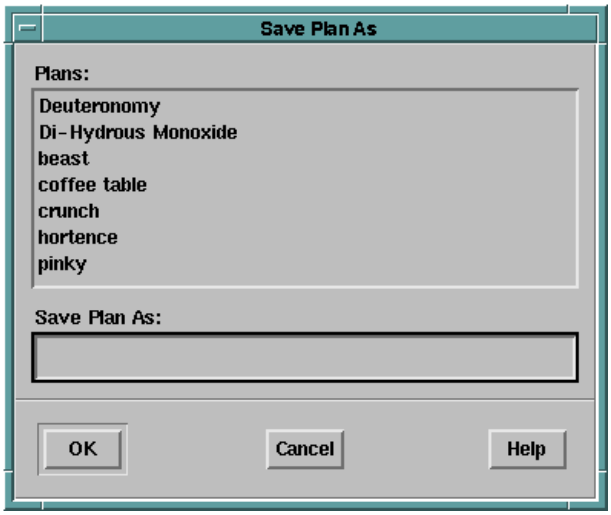


Figure 8.5.6-1. Save As Plan Dialog Box

8.5.7 Deleting Plans

Once you are through using a what-if plan you should delete it. Deleting a plan will remove the plan and all scheduled activities from the database. This means that the scheduled instances of activities are removed from the database; the activity definitions are not affected. Removing unused What-if Plans will reduce the total number of plans in the Scheduling system, and improve system performance when working with plans.

You must be the creator of a plan you wish to delete. In addition, the Master Plan cannot be deleted since it is the basis for generating the ATC load and Ground Script.

To delete a plan:

1. Choose **Delete…** under the File menu of the Timeline. The Delete Plan dialog box opens (see Figure 8.5.7-1).
2. Select the name of the plan you wish to delete from the list of available plans.
3. Click **OK**. A confirmation dialog box opens. Select the appropriate response. The Delete Plan dialog box disappears. If you wish to delete more than one plan click **Apply** on the Delete Plan dialog box. Doing so will leave the Delete Plan dialog box up for you to select another plan.

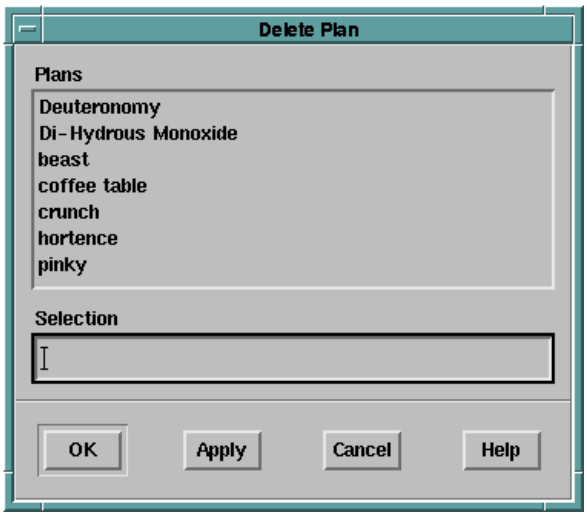


Figure 8.5.7-1. Delete Plan Dialog Box

8.5.8 Printing a Plan

The Planning and Scheduling subsystem provides a PostScript Timeline to print and view any portion of the mission schedule. The PostScript Timeline allows you to view and print a graphical timeline plot of a mission schedule in greyscale or color, and to generate a PostScript version of the Timeline plot. You may start the PostScript Timeline via the Print option under the Timeline File menu, as described below. You need specify the Start/Stop time, as well as options such as Orientation/Page Size, and Destination Printer on the PostScript Timeline dialog box.

8.5.8.1 Setting Up the Printer Name

To print the Timeline, you should set up the printer names in the FOS setup file. The printer name variables such as “theLetterPrinter,” “theLegalPrinter,” and “theTabloidPrinter” must be set up correctly to send the print request of the PostScript Timeline to the printer corresponding to the paper size selected on the PostScript Timeline dialog box.

8.5.8.2 Setting Up the Preview Tool Name

The PostScript Timeline allows you to preview the Timeline printout using PostScript preview tools such as “pageview” and “ghostview”. To set up the preview tool, you need to determine if the PostScript preview tools are available on the system. If the PostScript preview tool is available, you should specify the tool name variable “thePreviewTool” in FOS set up file. If you do not specify the PostScript preview tool name, the “Preview” button on the PostScript Timeline dialog box will be greyed out.

8.5.8.3 Running the PostScript Timeline

To start the PostScript Timeline, there needs to be at least one plan open on Timeline. If there is no current open plan, the **Print** option on the Timeline main window File menu will be greyed out.

1. Select **Print…** from the File menu on the Timeline's main window. The PostScript Timeline dialog box opens, displaying the Start/Stop time and hours/page for the current open plan (see Figure 8.5.8.3-1).

2. Select **Orientation, Paper Size**, and **Destination** option menus from PostScript Timeline dialog box. For the destination "Printer," provide a print command in the "Command" text field to print a PostScript file. For the destination "File," provide a filename including full path in the "Filename" text field. If no path is specified, the file will be saved in the current directory.

3. Click **OK**. If the Destination is "File," it will generate a PostScript file with the filename provided in the "Filename" text field. If the Destination is "Printer," the print request will be sent to the printer corresponding to PaperSize selected on the PostScript Timeline dialog box.

To preview output:

Click **Preview**. The PostScript Preview window opens (see Figure 8.5.8.3-2).

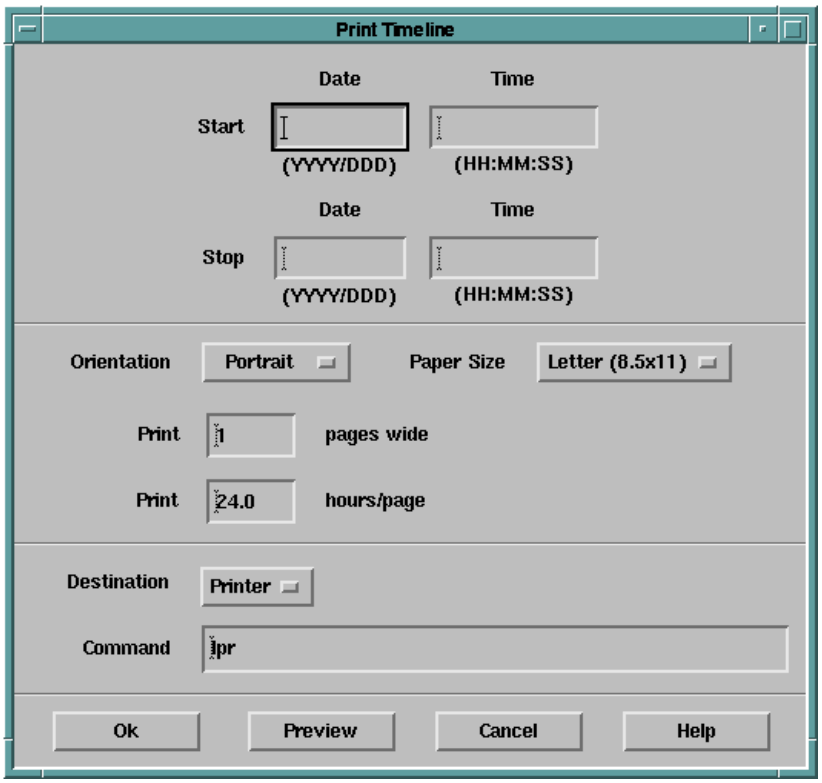


Figure 8.5.8.3-1. PostScript Timeline Dialog Box

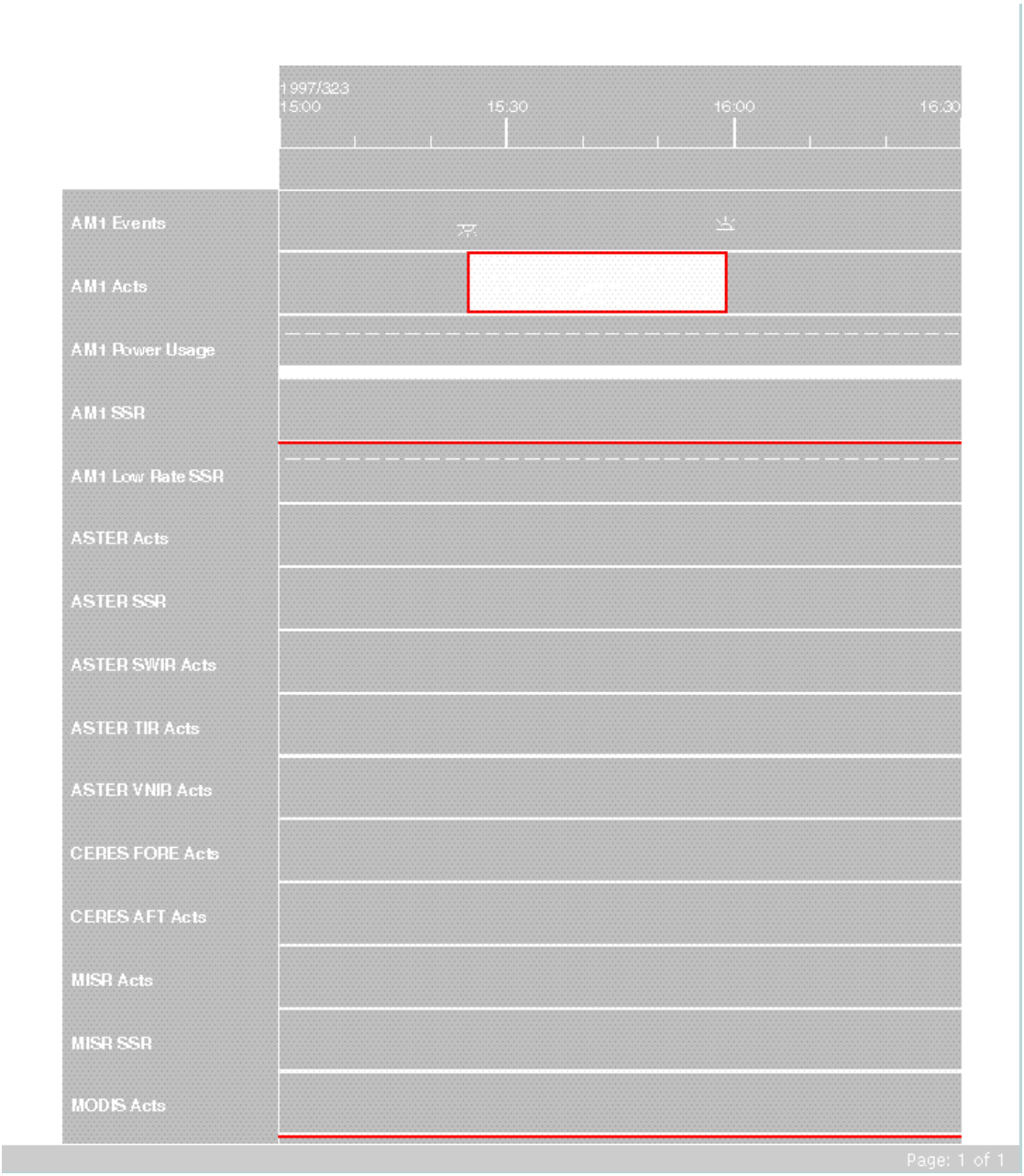


Figure 8.5.8.3-2. PostScript Preview Window

8.5.9 Configuring the Timeline

The Timeline tool allows you to configure its display to suit your particular needs. You can change the time you are viewing along with the time duration. If you want to see other resources you can scroll through those currently visible or add and remove resources. Since there are a large number of orbital events, you can view as many or as few as you like, or split them onto different Timeline display regions.

8.5.9.1 Changing the Time Range Visible

The time range visible on the Timeline can be modified to show a larger or smaller time range in order to see more or fewer scheduled activities and events.

To change the time range viewed on the Timeline:

1. From the Timeline's View menu, click **Time Interval** and drag your mouse to the right. The View menu displays several time ranges to choose from.
2. Select the desired time range to display. The Timeline updates to display the selected time range.

8.5.9.2 Changing the Number of Resources

The Resource Display Region on the Timeline can be modified to show a larger or smaller number of resources on the Timeline.

To change the number of resources viewed on the Timeline:

1. From the Timeline's View menu, click **Subregions** and drag your mouse to the right. The View menu displays several values to choose from.
2. Select the desired value to display. The Timeline updates to display the selected number of resources.

8.5.9.3 Changing Resources, their Activities, Modes, and Events Displayed

Different users will want to display different resources modeled within the Scheduling software. IOTs will primarily want to display their own instruments along with the data buffer the instrument is writing data into, and orbital events they might be interested in. The FOT will want to display major spacecraft subsystems, including the communication subsystems to keep track of real-time contacts. Whether you are a member of an IOT or FOT, you can configure the Timeline display to fit your needs.

8.5.9.3.1 Adding a Resource Region

If a resource you are interested in is not a configured resource region, the Timeline tool allows you to add that resource region. The Resource Editor tool within the Timeline allows you to configure a region. You can also display resource information (either activity, mode, value, or event).

To add a resource region:

1. Choose **Resources…** from the User Setup menu. The Resource Editor dialog box opens (see Figure 8.5.9.3.1-1).
2. Select a new resource to display from the list of available resources.
3. Select whether you want to display activities, modes, or events. If you select event, click on the types of events you wish to display. Refer to the list of event definitions in Appendix B for information on events and how they are displayed on the Timeline.

4. Modify the name of the line (subregion name) as you would like it to appear on the left hand side of the Timeline. Typically for modes and activities you will have the resource name followed by either "Mode" or "Activity." If you select events, you might want to name it by some event category such as "Sun Events."

5. Click **Add**. The new region will be added to the list of regions currently viewed by the Timeline. The newly added regions will be added either at the bottom of the list or under the highlighted item in the selected subregions list.

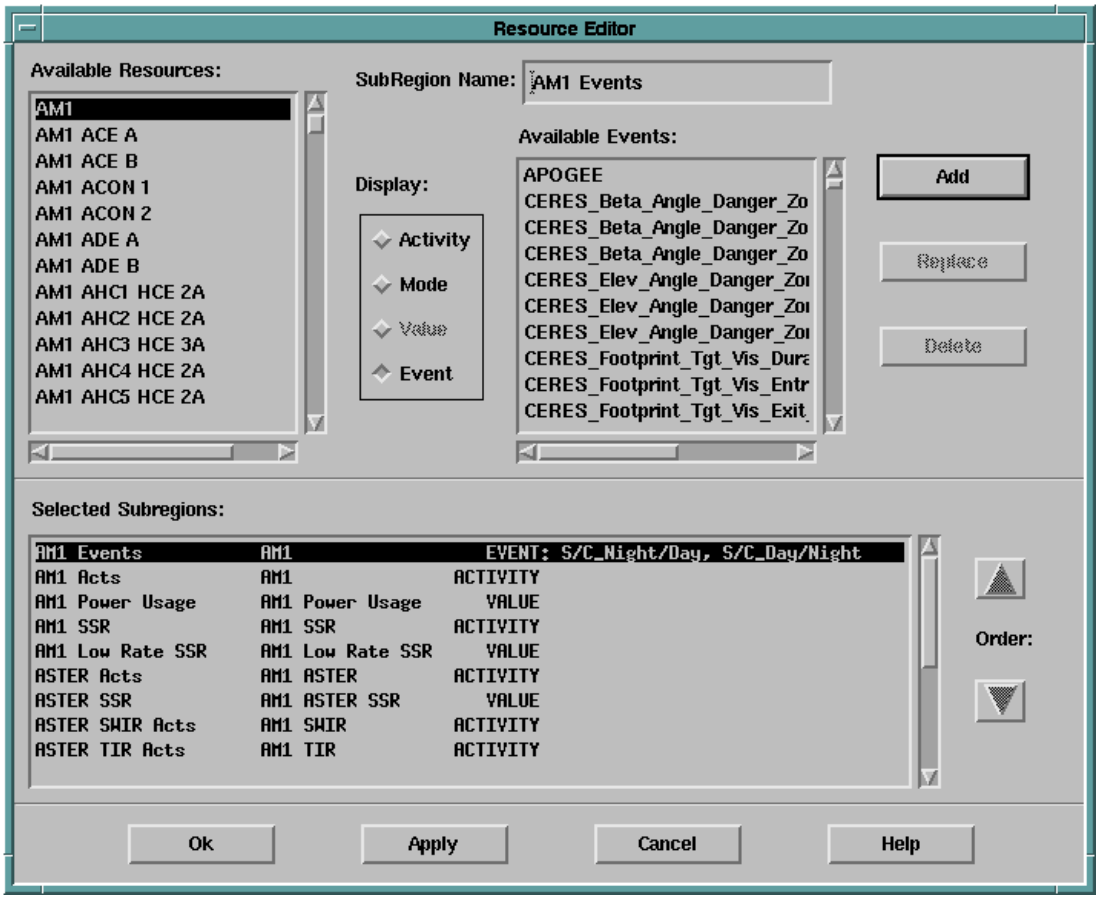


Figure 8.5.9.3.1-1. Resource Editor Dialog Box

6. Move the newly added resource region to its display position using the arrow buttons.

7. Click **OK** or **Apply** to administer the changes. A new line will be added into the Timeline's display for the selected resource. The activities, modes, or events occurring on the new region will be displayed for the currently open plan. The dialog box will close if **OK** is selected. If **Apply** is chosen, the dialog box will stay open, allowing you to make other modifications to the list of displayed Resources.

The list on the left of the top pane of the dialog box shows all available Resources. The list in the middle pane of the dialog box shows all selected subregions currently viewed by the Timeline.

Each subregion contains a subregion name, a resource, and what is displayed on that resource (either activities, modes, or a list of events).

8.5.9.3.2 Modifying a Resource Region

Resource regions currently configured on the Timeline may be modified to view different information (i.e., resource modes rather than activities). The Resource Editor tool within the Timeline allows you to configure a region to your liking.

To modify a resource region:

1. Choose **Resources...** from the User Setup menu. The Resource Editor dialog box opens.

   The list on the left of the top pane of the dialog box shows all available Resources. The list in the middle pane of the dialog box shows all selected subregions currently viewed by the Timeline. Each subregion contains a subregion name, a resource, and what is displayed on that resource (either activities, modes, or a list of events).

2. Select one of the regions already being displayed on the Timeline from the selected subregions list.

3. Select what new type of resource you wish to display (if you want a different resource).

4. Select whether you want to display activities, modes, or events. If you select event, click on the types of events you wish to display. Refer to the list of event definitions in Appendix B for information on events and how they are displayed on the Timeline.

5. Modify the name of the line as you would like it to appear on the left hand side of the Timeline. Typically for modes and activities you will have the resource name followed by either "Mode" or "Activity." If you select events, you might want to name it by some event category such as "Sun Events."

6. Click **Replace**. The new region will replace the existing region in the same position in the list.

7. If desired, move the newly added resource region to the position you wish to see it on the Timeline display.

8. Click **OK** or **Apply** to administer the changes. The new line will be added into the Timeline's display for the selected resource. The activities, modes, or events occurring on the new region will be displayed for the currently open plan. The dialog box will close if **OK** is selected. If **Apply** is chosen, the dialog box will stay open, allowing you to make other modifications to the list of displayed Resources.

8.5.9.3.3 Removing a Resource Region

If there are resource regions currently configured on the Timeline that you do not want to view, the Resource Editor tool within the Timeline allows you the ability to remove the regions.

To remove a resource region:

1. Choose **Resources…** from the User Setup menu. The Resource Editor dialog box opens (see Figure 8.5.9.3.1-1).

The list on the left of the first pane of the dialog box shows all available Resources. The list in the middle pane of the dialog box shows all selected subregions currently viewed by the Timeline. Each subregion contains a subregion name, a resource, and what is displayed on that resource (either activities, modes, or a list of events).

2. Select a region already being displayed on the Timeline.
3. Click **Delete**. The resource region will be removed from the list of currently displayed regions on the Timeline.
4. Click **OK** or **Apply** to administer the changes. The line will be deleted from the Timeline. The dialog box will close if **OK** is selected. If **Apply** is chosen, the dialog box will stay open allowing you to make other modifications to the list of displayed Resources.

8.5.9.3.4 Ordering Resource Regions

The Resource Editor tool within the Timeline, allows the ability to order resource regions to your liking.

To change the ordering of resource regions:

1. Choose **Resources…** from the User Setup menu. The Resource Editing dialog box opens (see Figure 8.5.9.3.1-1).

The list on the left of the first pane of the dialog box shows all available Resources. The list in the middle pane of the dialog box shows all selected subregions currently viewed by the Timeline. Each subregion contains a subregion name, a resource, and what is displayed on that resource (either activities, modes, or a list of events).

2. Select the region you wish to reorder from the selected subregions list.
3. Click the arrow buttons to move the region to the position you wish to view it on the Timeline.
4. Click **OK** or **Apply** to administer the changes. The line will be moved on the Timeline's display. The dialog box will close if **OK** is selected. If **Apply** is chosen, the dialog box will stay open, allowing you to make other modifications to the list of displayed Resources.

8.5.9.4 Changing the Colors Used by the Timeline

The Color Selection dialog box enables you to select the colors the Timeline uses to display scheduled activities and modes. Open the Color Selection dialog box (see Figure 8.5.9.4-1) by selecting **Colors** from the User Setup menu. The Color Selection dialog box consists of a color palette and a list of activities and modes currently visible on the active plan.

To change the color of an activity or mode:

1. Choose **Color Selection…** from the User Setup menu. The Color Selection dialog box opens (see Figure 8.5.9.4-1).
2. Select the name of the desired activity or mode.
3. Select a color to be displayed for that activity or mode. The new color will be displayed in the large color bar under the palette. This provides an example of what an activity or event would look like on the Timeline.
4. Click **OK** or **Apply** to display the changes. The activity or mode will change color on the Timeline display. Clicking **Apply** allows you to change the colors for other activities or modes, while **OK** dismisses the color selection dialog box entirely.

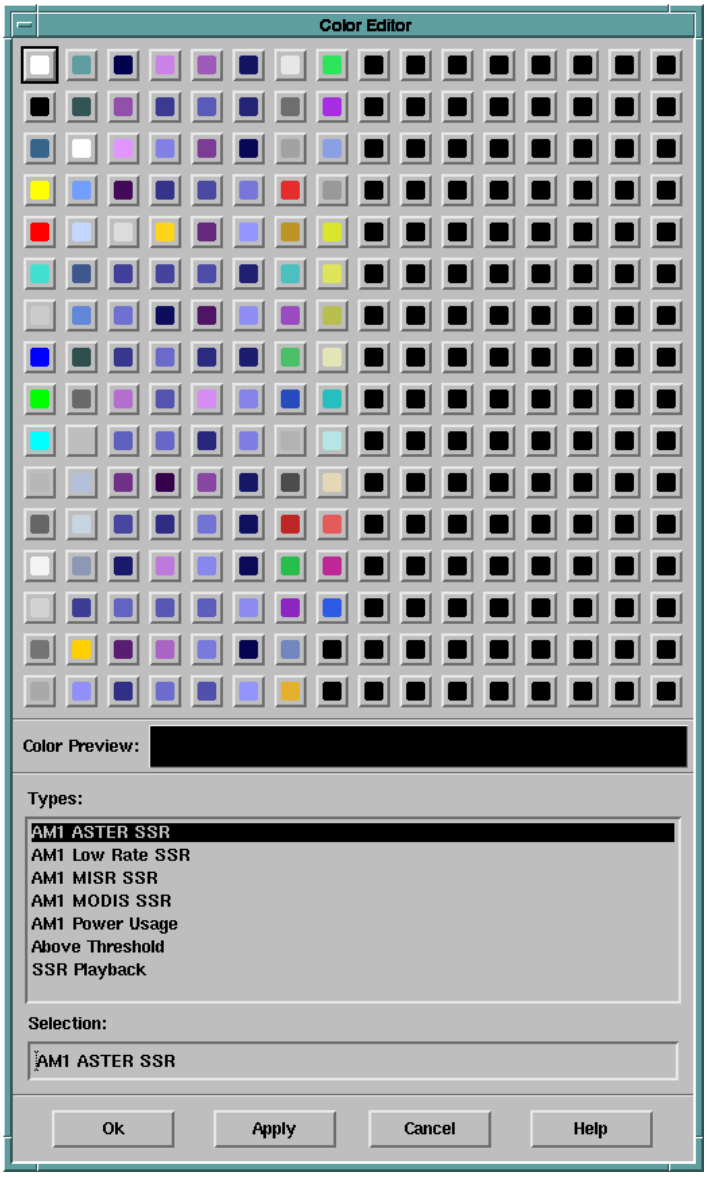


Figure 8.5.9.4-1. Color Selection Dialog Box

8.5.9.5 Loading and Saving Different Configurations

The Timeline allows you to save the Timeline configuration in a file that may be loaded later. You may store several different configurations depending on the type of resources, activities, modes, and events you are interested in. This allows the FOT to standardize a configuration so that when the FOT and an IOT discuss a schedule conflict, they see the same resources, colors, etc., on their Timelines. In order to save or load a Timeline configuration file, use the Save Setup dialog box (see Figure 8.5.9.5-1) or the Load Setup dialog box (see Figure 8.5.9.5-2). Both are accessed via the Timeline.

The Save Setup dialog box defaults to the directory given in the Filter at the top of the window. Any directories found matching the Filter are displayed in the selection list on the left of the dialog box. Any files matching the Filter are displayed in the selection list on the right of the dialog box. The currently selected directory or file is displayed in the Selection text field at the bottom of the window.

To change the filter for the file selection dialog:

1. In the Filter text entry field, type the path of the directory where the file will be stored, followed by a wildcard string.
2. Press <Return> or click **Filter**.

The selected directory opens with its contents displayed in the dialog box. Directories are displayed on the left and files on the right. The Selection field at the bottom of the dialog box displays the name of the currently opened directory.

The "*" character represents a wildcard in the filter text entry field. For example, to see all files ending with ".cfg", type *.cfg. You can use numerous "*" characters as well. For example, to see all files containing the string "planning" and ending with ".cfg", type *planning*.cfg for the wildcard string. In order to see all files, simply use "*" for the wildcard string.

To browse directories in the file selection dialog box:

1. To explore a directory, double click on the directory you wish to open from the list of directories.
2. To go up a directory, double click on the directory **".."** displayed in the list of directories.

The selected directory will open with its contents displayed in the dialog box.

To save the Timeline's configuration:

1. Choose **Save Setup…** under the User Setup menu. The Save Setup dialog box opens.
2. Select the directory where the configuration file will be stored.
3. Type the configuration file's name in the Selection field. To over-write an existing configuration file, double click on a listed file.
4. Click **OK**.

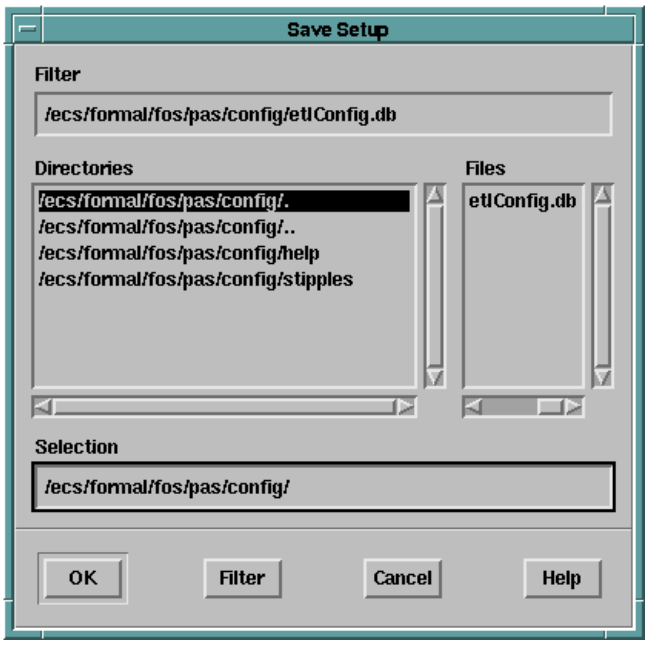


Figure 8.5.9.5-1. Save Setup Dialog Box

The name of the configuration file need not be in any particular format. However, the default configuration files provided with the scheduling system will end with the suffix "cfg". For consistency, all configuration files should end with ".cfg". This saves a Timeline configuration to the selected file.

To load a Timeline configuration:

1. Select **Load Setup…** from the User Setup menu. The Load Setup dialog box opens.
2. Select the directory containing the configuration file to be used.
3. Select the configuration file desired and click **OK** or double click on the configuration file to be used. The Timeline will update its configuration to reflect the configuration in the file.

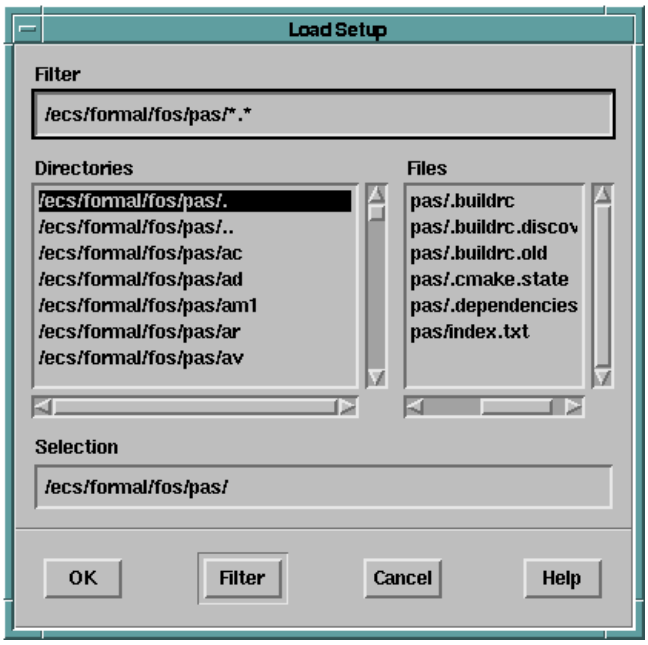


Figure 8.5.9.5-2. Load Setup Dialog Box

8.5.10 Controlling Access to Plans Through Permissions

When you create a new What-if Plan by creating either a new plan or saving a plan as another plan, you become the owner of the new plan based on your user role. The user role is the name you used to login to the IST. If you own a plan, you have permission to modify any resource on that plan, including those resources you do not normally have permission to modify on the Master Plan. Any other user will be unable to modify a plan that you create unless you give them permission to do so.

The FOT is the owner of the Master Plan and therefore has full permission to modify any activity on any resource. The FOT must give permission to IOTs in order for them to be able to allocate activities to IOT resources on the Master Plan. Permissions will already be given to IOTs on the Master Plan at the start of the mission.

Similarly, if an IOT creates a What-if Plan, they have full permission to modify all activities on any resource on that plan. If an IOT wishes to allow another IOT or the FOT to make scheduling changes on their What-if Plan, they must give their permission.

Permissions are given on a resource-by-resource basis. For example, if you want to give another IOT permission to allocate activities on resource A, you add their role to the list of roles that can modify resource A on that plan.

It is possible to give permission to other users through the Timeline. You do not have to open a plan to modify permissions on it.

8.5.10.1 Adding Permissions to a Plan

To add permissions for another user to modify your plan:

1. Select **Permissions...** under the Timeline File menu on the Timeline. The Permissions dialog box opens (see Figure 8.5.10.1-1). The list of plans and their owners will be displayed in the upper left portion of the permissions dialog box.

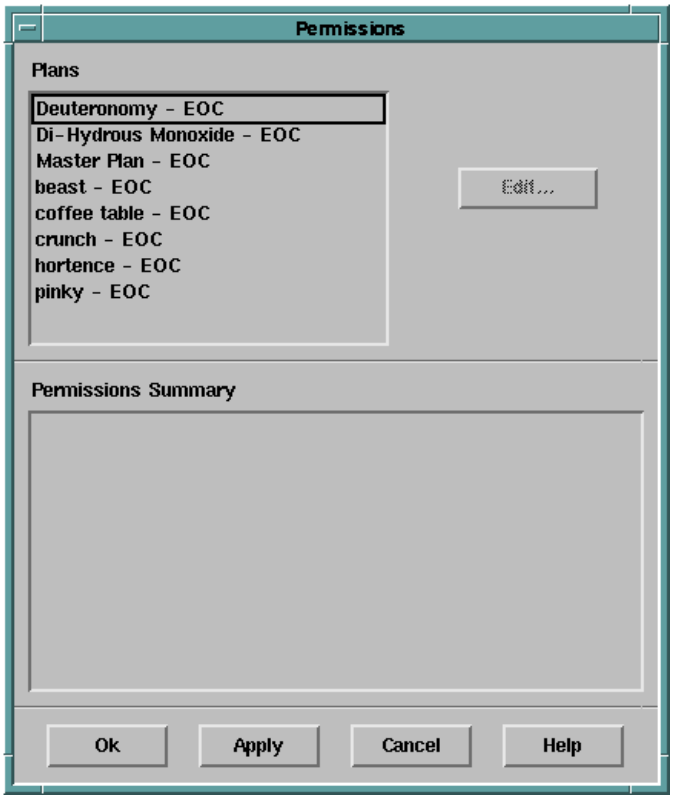


Figure 8.5.10.1-1. Permissions Dialog Box

2. Select the plan you wish to modify permissions for. A list of user roles and their permissions on the selected plan will be displayed in the Permissions Summary list.

3. Click **Edit...**The Permissions/Resource dialog box opens (see Figure 8.5.10.1-2). The list in the upper paragraph of the dialog box, User Roles, shows all available user roles. The list on the left side of the third paragraph of the dialog box, Available Resources, shows all schedulable resources. The list to the right, Selected Resources, shows any selected resources a user role may have permissions on.

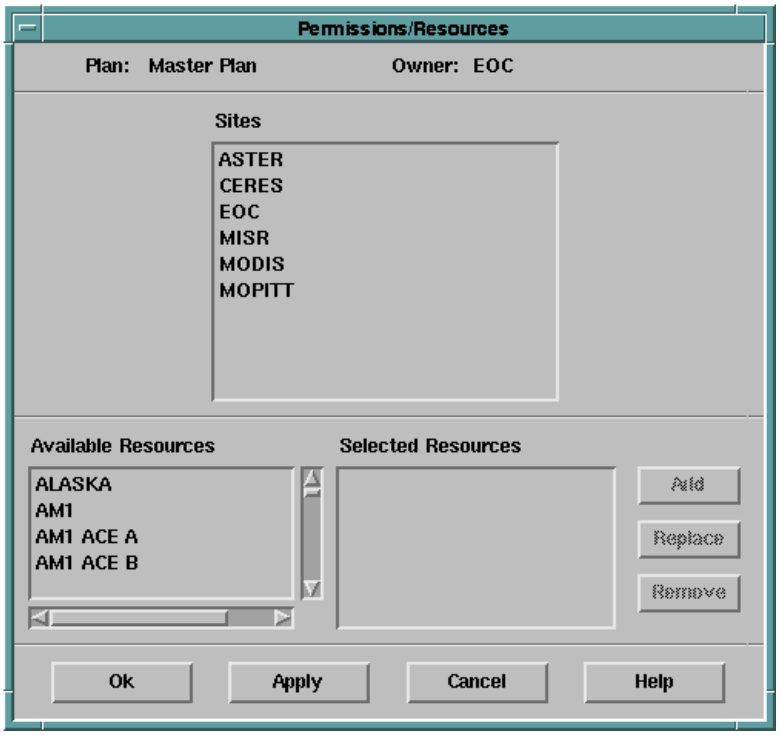


Figure 8.5.10.1-2. Permissions/Resource Dialog Box

4. Select a user role from the list. If the user role selected has any permissions on resources, those resources will be displayed in the Selected Resources list.

5. Select one or many resources from the Available Resources list and click **Add**. The resources selected will added to the Selected Resources list.

6. Click **OK** or **Apply** to administer the changes. The user role and their permissions will be added to the Permissions Summary list in the Permissions dialog box. The Permissions/Resource dialog box will close if **OK** is selected. If **Apply** is chosen, the dialog box will stay open, allowing you to add additional permissions.

7. Click **OK** or **Apply** within the Permissions dialog box to save the new permissions. The new permissions will be saved to the database and the permissions will be distributed throughout the system.

8.5.10.2 Modifying Permissions on a Plan

To modify permissions for another user on your plan:

1. Select **Permissions…** under the File menu on the Timeline. The Permissions dialog box opens (see Figure 8.5.10.1-1). The list of plans and their owners will be displayed in the upper left portion of the permissions dialog box.

2. Select the plan you wish to modify permissions for. A list of user roles and their permissions on the selected plan will be displayed in the Permissions Summary list.

3. Select one of the permissions from the Permissions Summary list and click **Edit...**. The Permissions/Resource dialog box opens (see Figure 8.5.10.1-2). The current user role will be selected in the User Roles list in the Permissions/Resource dialog box. The Selected Resources list will contain any selected resources that user role currently has permissions on.

4. Select one or many resources from the Available Resources list and select one or many resources from the Selected Resources list. Click **Replace**. The resources selected from the Available Resources list will replace the resources selected from the Selected Resources list.

5. Click **OK** or **Apply** to administer the changes. The user role and their permissions will be updated in the Permissions Summary list in the Permissions/Resource dialog box (see Figure 8.5.10.1-2). The Permissions/Resource dialog box will close if **OK** is selected. If **Apply** is chosen, the dialog box will stay open, allowing you to modify additional permissions.

6. Click **OK** or **Apply** in the Permissions/Resource dialog box to save the new permissions. The new permissions will be saved to the database and will be distributed throughout the system.

8.5.10.3 Removing Permissions from a Plan

To remove permissions from another user on your plan:

1. Select **Permissions…** under the File menu on the Timeline. The Permissions dialog box opens. The list of plans and their owners will be displayed in the upper left portion of the permissions dialog box.

2. Select the plan you wish to modify permissions for. A list of user roles and their permissions on the selected plan will be displayed in the Permissions Summary list.

3. Select one of the permissions from the Permissions Summary list and click **Edit...**. The Permissions/Resource dialog box opens (see Figure 8.5.10.1-2). The current user role will be selected in the User Roles list in the Permissions/Resource dialog box. The Selected Resources list will contain any selected resources that user role currently has permissions on.

4. Select one or many resources from the Selected Resources list and click **Remove**. The selected resources will be removed from the Selected Resources list.

5. Click **OK** or **Apply** to administer the changes. The user role and their permissions will be updated in the Permissions Summary list in the Permissions dialog box. The Permissions/Resource dialog box will close if **OK** is selected. If **Apply** is chosen, the dialog box will stay up, allowing you to modify additional permissions.

6. Click **OK** or **Apply** within the Permissions dialog box to save the new permissions. The modified permissions will be saved to the database and the permissions will be distributed throughout the system.

8.5.11 Viewing Detailed Activity Schedule Time

Once a Detailed Activity Schedule (DAS) has been generated for the Master Plan (Refer to paragraph 8.5.1, Generating ATC Loads), the Timeline displays a vertical line denoting the DAS time. Any activities starting before the DAS time will be outlined in red and have "DAS" displayed in the upper right portion of the activity box. This is to indicate that the activities are "frozen" and cannot be rescheduled or deleted, unless you unfreeze a portion of the master plan. (See Figure 8.5.11-1).

To view DAS time on the Master Plan:

Open the Master Plan during the time range surrounding the DAS. The Timeline tool will open the Master Plan over the desired duration. A vertical DAS line appears at the DAS time; all scheduled activities before the DAS line will be shown in red outline, denoting them as being in a DAS.

8.5.12 Viewing Constraint Information

When a scheduled activity definition causes a constraint violation, the Timeline tool will identify the scheduled activity in violation. Scheduled activities violating a soft constraint will contain forward hash marks, "/ / /" (see Figure 8.5.12-1). Scheduled activities violating a hard constraint will contain cross-hash marks, "XXX" (see Figure 8.5.12-2).

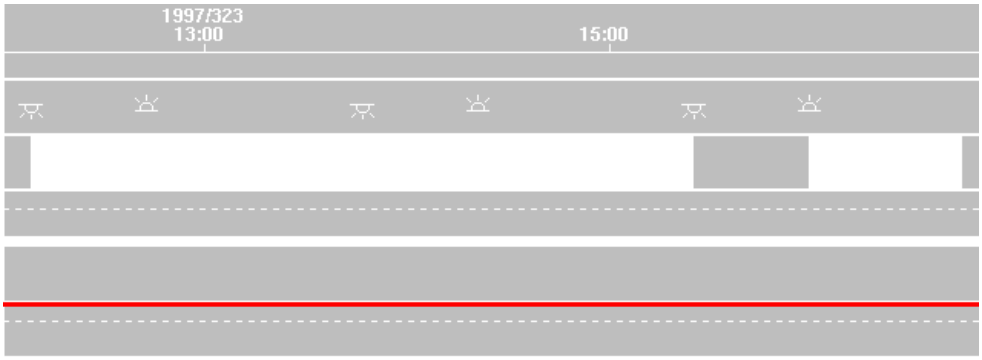


Figure 8.5.12-1. Soft Constraint Violation

Figure 8.5.12-2. Hard Constraint Violation

To view the constraint the scheduled activity is violating:

1. On the Timeline window, click on the scheduled activity or mode in violation.

The scheduled activity and any mode transitions caused by the scheduled activity will be highlighted by black handle bars at the ends of the rectangle representing the scheduled activity.

2. Select **Constraint Info** under the View menu option from the Timeline's menu bar or click **Constraint Info**.

The Constraint Information dialog box (see Figure 8.5.12-3) opens to display any constraints the scheduled activity is violating.

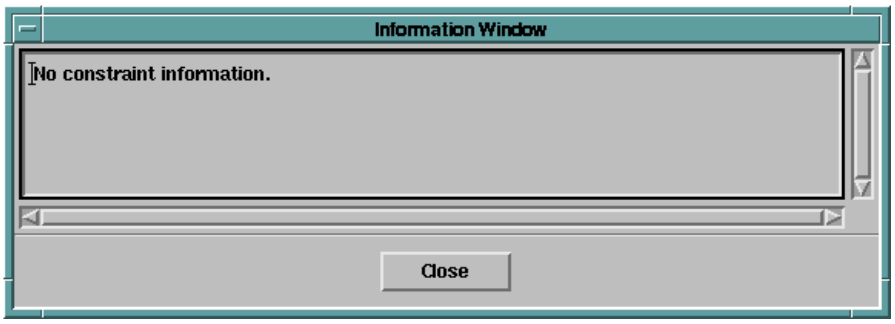


Figure 8.5.12-3. Constraint Information Dialog Box

8.5.13 Dealing with Merging Plans and Global Visibility

The Timeline tool allows you to see changes that other users may be making at another IST or the EOC. When another user saves a plan, any changes made to that plan are distributed throughout the system. The changes are visible to any user that has that plan open and active on their Timeline, whether it is the FOT at the EOC or an IOT at an IST.

Since the distribution of changes is immediate, you may see the plan you are displaying update itself automatically to account for changes the other user may have made. This occurs because the plan the other user saved is merging with yours. Although it may be disconcerting to see your plan suddenly start changing, your changes will remain intact since there is a built-in mechanism to prevent users from scheduling on top of each other on the same plan, on the same resource, over the same time period.

There is an advantage of having global visibility. Since you will see changes immediately, you will be able to see conflicts sooner and resolve them earlier, helping to come up with optimal, conflict-free schedules.

8.6 Scheduling

The three scheduler tools allow you to modify plans by scheduling a variety of different items. Which scheduler to use depends upon the type of item you are scheduling. With the General Scheduler, which is the most versatile scheduler, you may schedule using an activity definition, constraint definition, command, or procedure. Use the Communications Contact Scheduler to schedule a TDRSS or ground network communications contact activity. Schedule a load uplink activity with the Load Uplink Scheduler.

The FOT may use all three scheduler tools, while the IOT uses only the General Scheduler. You may perform a number of functions with the scheduler tools:

a. Schedule an activity.

b. Unschedule an activity.

c. Modify (or "reschedule") an already scheduled activity.

d. Modify parameters in an applicable activity.

Paragraphs 8.6.1 ("Scheduling an Activity") and 8.6.2 ("Editing a Scheduled Activity") apply to all three schedulers; however, you will first be shown how to bring up and perform tasks with the General Scheduler. Therefore, these two paragraphs will refer to the General Scheduler, although you can perform the same tasks with the other schedulers (only on different types of activities). Paragraphs 8.6.3 through 8.6.5 detail additional features specific to the General Scheduler, Communications Contact Scheduler, and Load Uplink Scheduler.

To start the General Scheduler:

1. Click **Tools...** on the Control window. The Tools dialog box opens up.
2. To filter the Scheduling tools only, Select **Planning and Scheduling** from the Tool Type option menu.
3. Select **General Scheduler** from the list of Planning and Scheduling tools.
4. Click **OK**. The Tools dialog box closes and the General Scheduler starts up.

The General Scheduler's main display consists of five regions:

1. Menu bar.

2. Tool bar.
3. Activities, constraints, and Commands and Procedures list.
4. Open Plans list.
5. Time Selection area.

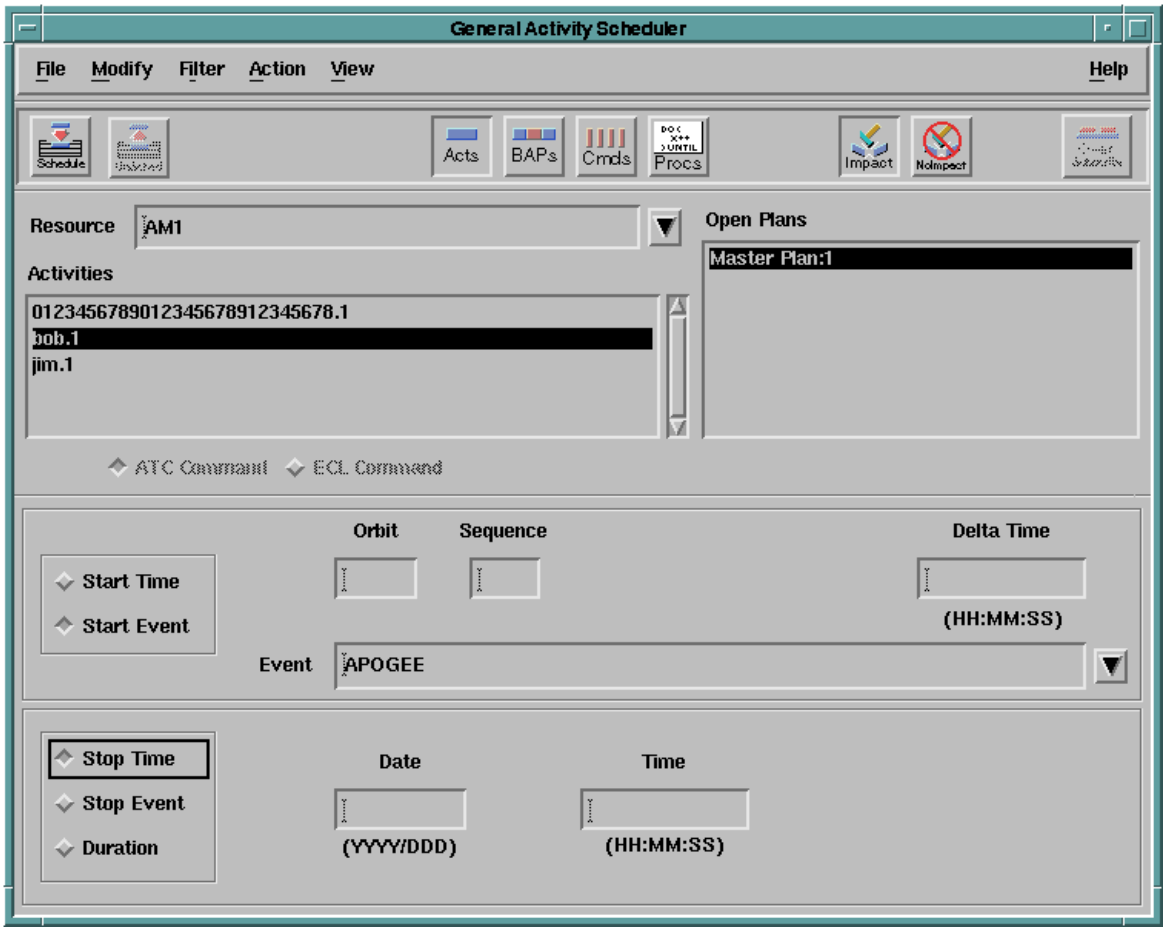


Figure 8.6-1. General Scheduler Window

8.6.1 Scheduling an Activity

You may schedule an activity definition using the General Scheduler. The activity must be defined and present in the database in order to be scheduled.

To schedule an activity:

1. If a plan is not open, open one via the Timeline tool.
2. From the Filter menu of the General Scheduler window, select **Activities** or click **acts**. Activities are displayed in the Activities list. Activities in the list will be filtered by the Resource Name currently selected above the Activities list.

3. Click on the Resource Option menu above the Activities list and drag to the desired resource. The selected Resource Name is displayed and the Activities list is filtered to show activities related to that Resource Name.

4. Click on the desired activity from the Activities list.

5. Select the plan on which you would like to schedule the activity from the list of open plans.

6. Set the scheduling mode.

7. Specify the Start and Stop times for the activity (See section 8.6.1.1 below).

8. Select **Schedule** from the Action menu, or click **Schedule**. This puts the activity on the schedule. If the corresponding plan, resource, and time span are visible on the Timeline, the Timeline will display the scheduled activity.

By default, the scheduled activity's duration will be set to the activity's minimum possible duration based on the command offsets in the activity definition. For example, if an activity definition has command A defined to execute ten seconds after start time, and command B defined to execute twenty seconds before stop time, then its minimum activity duration is thirty-one seconds (ten plus twenty plus one) to ensure that command B occurs after command A. You may override this behavior by specifying a time period longer than the activity's minimum duration in order to reserve that extra time on the schedule.

8.6.1.1 Specifying Activity Times

You may specify the interval over which you would like to schedule an activity in a number of ways. You may enter start and stop times either as an absolute time (e.g., year 1999, day of year 118, at 12:00:00), or as the time associated with an orbital event (e.g., the first occurrence of SC DAY/NIGHT in orbit 231). In addition to using absolute times and orbital events, you may define the stop time by specifying a start time and activity duration (e.g., starting at 12:00 and lasting for 6 hours).

Remember that you can specify dates in one of the three formats: DayOfYear, MonthDayYear, and DayMonthYear. The General Scheduler displays dates appropriately according to the format that you have selected. You need to enter dates conforming to the format that you have selected; otherwise, an error will be reported. The following discussion assumes the DayOfYear format.

The valid combinations for specifying a time interval for scheduling an activity are:

1. Start as an absolute time, stop as absolute time.
2. Start as an absolute time, stop time associated with an orbital event
3. Start as an absolute time, stop as a duration.
4. Start associated with an orbital event, stop as absolute time.
5. Start associated with an orbital event, stop time associated with an orbital event.
6. Start associated with an orbital event, stop as a duration.

8.6.1.1.1 Specifying an Absolute Time

To specify the start or stop time as an absolute time:

1. In the Time Selection area of the General Scheduler window, select either **Start Time** or **Stop Time** (see Figure 8.6.1.1.1-1). The General Scheduler Time Selection area changes to show either the start or stop time date and time field text entries.
2. In the Date text entry field, input the date in year/day of year day format (YYYY/DDD). You must specify the full four-digit year, though the day may have one through three digits.
3. In the Time text entry field, input the time of day in the format HH:MM:SS.SSS. You must include hours, minutes, and seconds, delimited by colons. The milliseconds field is optional.

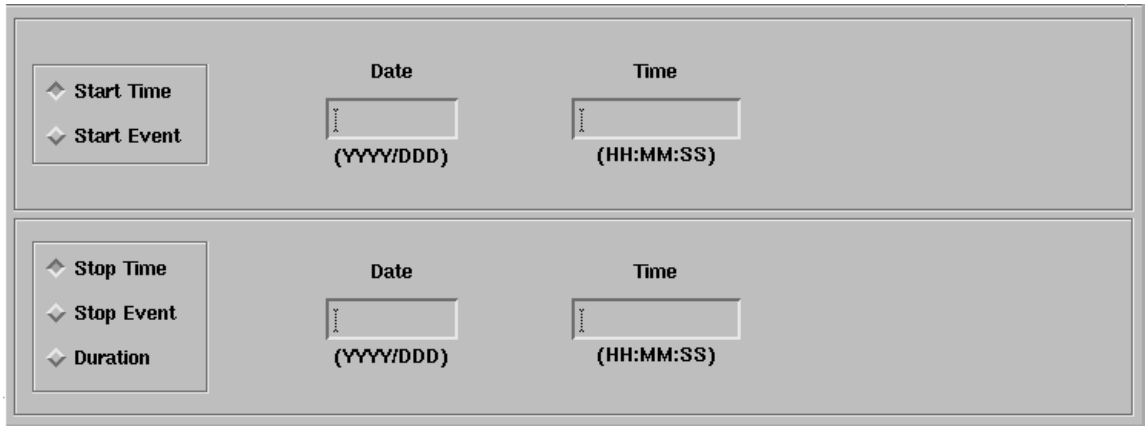


Figure 8.6.1.1.1-1. Time Selection Area of the General Scheduler Window

8.6.1.1.2 Specifying Time Based on an Orbital Event

1. Select either **Start Event** or **Stop Event** in the Time Selection area of the General Scheduler window (see Figure 8.6.1.1.2-1). The General Scheduler Time Selection area displays either the start or stop orbital event text entries and option menu.

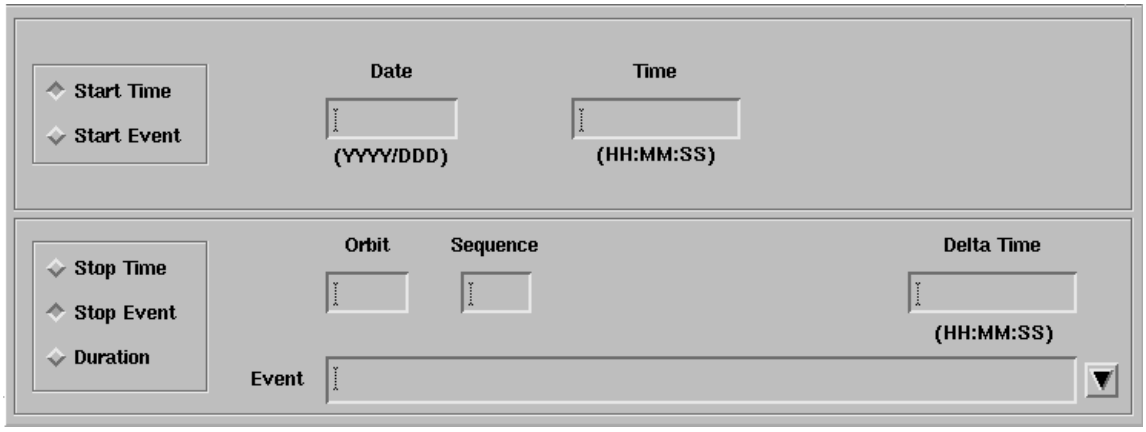


Figure 8.6.1.1.2-1. Start and Stop Event Radio Buttons

2. Select the name of the orbital event from the Event menu.
3. In the Orbit text entry field, enter either the orbit number or the orbital event.
4. In the sequence text entry field, enter the occurrence of the orbital event. This number uniquely identifies the desired orbital event in case the event occurs more than once during an orbit. The occurrence of the orbital event will typically be 1, since most events occur only once per orbit. If an event occurs more than once per orbit, the second occurrence will have a sequence number of 2; the third, 3; etc. Should you enter an invalid value for either the orbit or sequence number, a dialog box alerts you that an event of that type during the specified orbit and sequence does not exist.
5. In the Delta Time text entry field, enter the offset from the orbital event in the format +/- HH:MM:SS.SSS.

   SHORTCUT: Rather than typing in the event information, you may replace steps 2 through 4 by simply double clicking on the symbol of the desired event where it is displayed on the timeline.

8.6.1.1.3 Specifying Stop Time by Duration

You may specify stop time by entering a duration, which is added to the start time to determine the stop time.

1. In the Time Selection area of the General Scheduler window, select Duration (see Figure 8.6.1.1.3-1). The lower half of the General Scheduler Time Selection area will change to show the Duration value text entry and the Duration unit option menu.

Figure 8.6.1.1.3-1. Stop and Start Time Duration Radio Buttons

2. In the Duration text entry field, enter the duration value. You may use a whole or floating point number; for example "1," "1.0," and "1.5" are all valid.

3. From the Duration Unit option menu, select the duration unit, Second, Minute, Hour, Orbit, HH:MM:SS, or MM:SS.

   If you select HH:MM:SS or MM:SS, the duration value must match exactly the format you selected. For example, you may choose HH:MM and enter "01:30" for an hour and thirty minutes; alternatively, you could select Hour for the unit and enter "1.5."

8.6.1.2 Scheduling Modes

You may place a scheduler or the timeline into one of three scheduling modes: Impact, Non-impact, or Non-impact with Oversubscription. The scheduling mode determines the manner in which activities are placed in a schedule and the effect on activities already existing in the schedule. The term "scheduling mode" is unrelated to the alternate usage of the term "mode" in the phrase "instrument mode."

The scheduling mode may be changed using the tool bar or pull-down menu. On the schedulers, modes are under the Action menu; on the timeline, modes are under the Schedule menu.

Regardless of the scheduling mode, the General Scheduler will not place an activity on the plan if it causes mode transitions (i.e., changes in a resource's mode) at the same time on the same resource. If the scheduler tool allowed this to occur, the system would be unable to determine into which mode the transitions actually put the resource.

When scheduling a BAP with impact scheduling you will remove all activities for the requested BAP duration. If you schedule a BAP in non-impact mode with over subscription you will overlap your BAP with all activities scheduled during that time range. This is NOT recommended because you will interleave commands within different activities and this can only be caught during command constraint checking and detailed activity schedule generation. When you schedule a BAP in non-impact mode without over subscription, only parts of the BAP will be scheduled

where nothing previous had been scheduled. The advantage of scheduling in impact mode is that you will remove everything existing beforehand. It is a good way to initially place many activities on the schedule. When you schedule a BAP from the General Scheduler and have another BAP installed, these activities will NOT be overwritten.

8.6.1.2.1 Impact Scheduling

When you schedule an activity in Impact mode, the newly scheduled activity deletes any overlapping, non-locked activities already on the schedule (and on the same plan and resource).

To select impact scheduling:

From the tool bar (see Figure 8.6.1.2.1-1) or Action menu select **Impact**. This puts the General Scheduler in Impact mode; all activities, constraints, commands, and procedures will impact (delete) overlapping activities already on the schedule.

Figure 8.6.1.2.1-1. Impact Radio Buttons

8.6.1.2.2 Non-Impact Scheduling

Non-Impact mode prevents you from scheduling an activity that would overlap with any activities already on the schedule.

To select Non-Impact Scheduling:

From the Action menu or the tool bar (see Figure 8.6.1.2.2-1), select **Non-Impact**. This sets Non-Impact mode; you will be able to schedule a new activity definition, commands, or procedure; these will be scheduled so that other pre-existing activities on the schedule will not be impacted if they overlap the incoming activity.

Figure 8.6.1.2.2-1. Non-Impact Schedule Radio Buttons

8.6.1.2.3 Non-Impact Scheduling with Oversubscription

Scheduling in Non-Impact mode with Oversubscription allows a new activity to be scheduled even if activities already exist on the schedule overlapping the new activity's time period. When scheduling in this manner you are effectively "oversubscribing" the resource by having it perform more than one activity at a time. Activities already on the schedule will remain on the schedule.

WARNING

Avoid scheduling in Non-Impact mode with Oversubscription whenever possible since overlapping activities may violate command level constraints.

To select Non-Impact Scheduling with Oversubscription:

Select **Oversubscription** from the Action menu or click **Oversubscription** (see Figure 8.6.1.2.3-1). The General Scheduler is now in the Non-Impact with Oversubscription mode. Any activity definition, command, or procedure will be scheduled overlapping any existing scheduled activities on the schedule, without changing these existing activities. This may result in some activities being constrained.

Figure 8.6.1.2.3-1. Oversubscription Radio Buttons

8.6.1.3 Overriding Default Parameters

Prior to scheduling an activity or command, you may override the parameters for its commands or procedures from the General Scheduler's Parameter window. Your override values will be associated with each new activity you schedule without affecting previously scheduled activities. (If you do not override any default parameters prior to scheduling an activity definition or command, the resulting scheduled activity will use the default parameter values.)

WARNING

The modified parameters remain on the display until you select a different activity or command from the Activities/Commands list on the General Scheduler window. At this point, the modified parameters entered will disappear from the window (although their values remain in any activities you scheduled while the parameters were visible in the General Scheduler window).

To modify parameters:

1. Select the Command or Activity for which you want to override parameter values. (Refer to paragraph 8.6.1 for details on selecting the desired activity, or paragraph 8.6.4.2 for details on selecting the desired command).

2. From the **Modify** menu, select **Parameters**. The Parameters dialog box opens (see Figure 8.6.1.3-1). At the top of the panel, the name of the activity or command, as well as the associated Resource Name will be displayed for reference.

3. From the list of command(s) in the activity, select the command whose parameters you wish to modify. The parameters associated with that command will be displayed in the Parameters list.

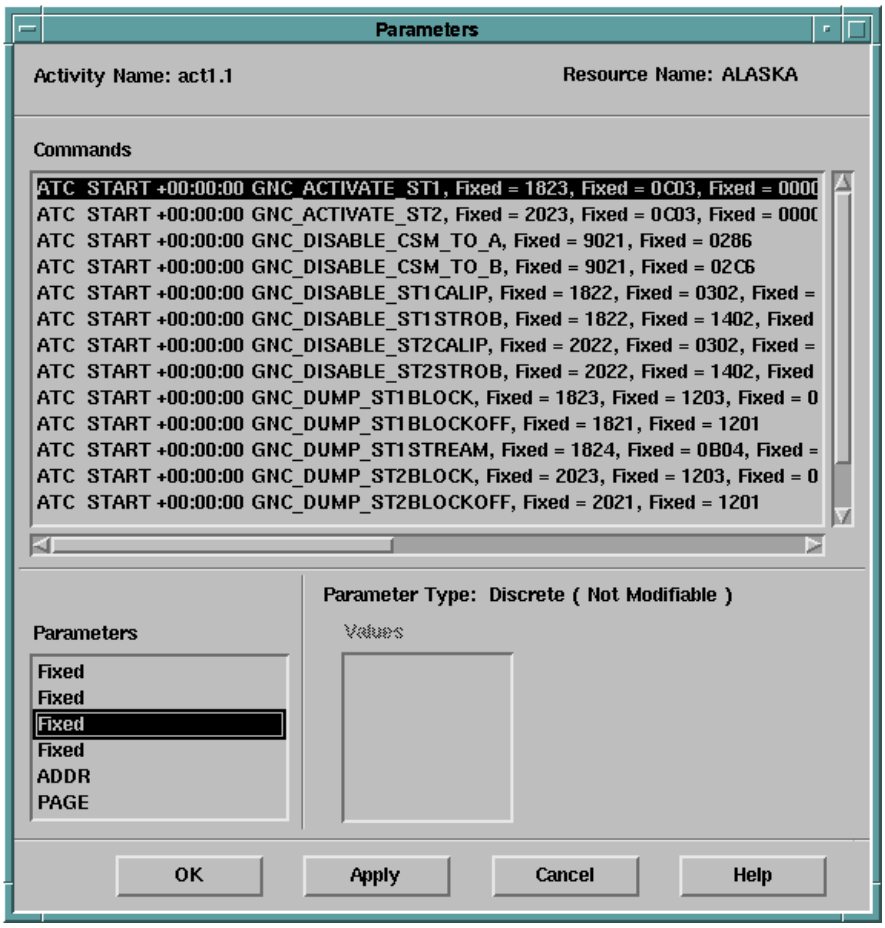


Figure 8.6.1.3-1. Parameters Dialog Box

4. From the Parameters list, select the parameter to modify. There are four different types of parameters: non-modifiable, floating number, enumerated (e.g., ON and OFF), or determined at scheduling time by a predefined algorithm. The Parameter Value area will change and show different choices depending upon the parameter type. If the parameter if of type Fixed value, you will not be able to respecify its value.

5. If the parameter is of type float, change the value of the parameter in the Current Value text entry field. The valid floating point range, displayed as the High/Low limit, is displayed for your reference just below the Current Value text field (see Figure 8.6.1.3-2).

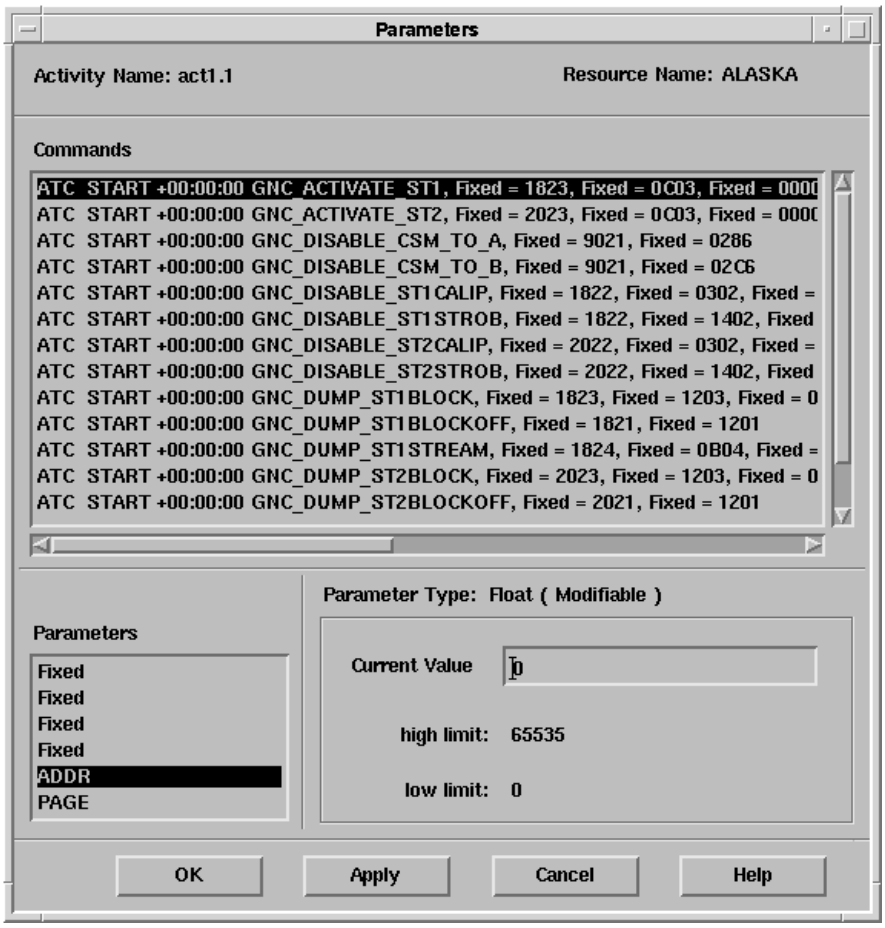


Figure 8.6.1.3-2. Floating Parameter Type

6. If the parameter is of type enumerated, change the value of the parameter by clicking on the desired value from the list of valid values (see Figure 8.6.1.3-3).

7. Click **Apply** to apply the changes and leave the window open or click **OK** to close the Parameters dialog box.

NOTE

A list of modified parameters associated with the selected activity or command on the main panel will be stored temporarily. Remember that if you choose another activity or command, the list of modified Parameter values which was built temporarily to be lost.

8. Click **Cancel** to leave the Parameters with their default values.

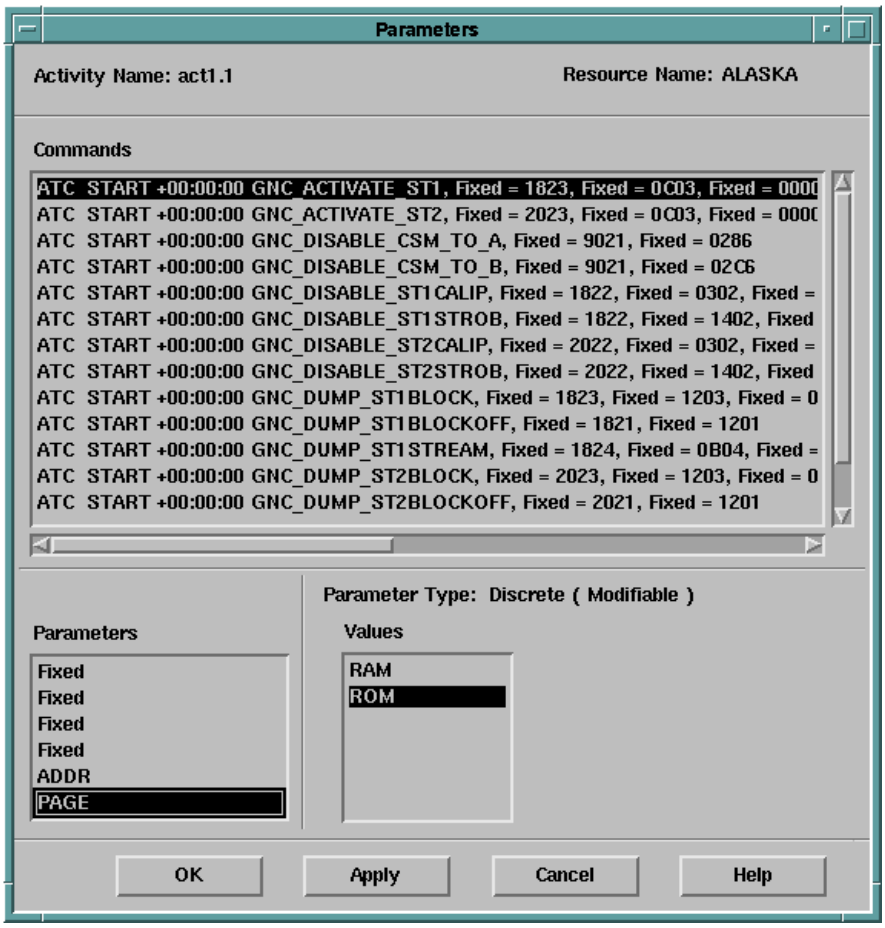


Figure 8.6.1.3-3. Enumerated Parameter Type

8.6.1.4 Viewing an Activity or BAP Definition

To view a definition for an activity or a BAP, use the General Scheduler View menu. First, select **Activity** or **BAP** from the Filter menu, or click **Activity** or **BAP**. Select the name of the Activity or the BAP that you want to view from the scrolled list of activities or BAPs. From the **View** menu, select **Activity Definition…** or **BAP Definition…** as appropriate. Figure 8.6.1.4-1 illustrates a activity Definition, but BAP definitions are analogous.

The Activity or BAP definition appears in a separate dialog box, as in Figure 8.6.1.4-1. For detailed explanations concerning the displayed information, refer to the Activity Definer and BAP Definer sections of this manual (paragraphs 8.2 and 8.3, respectively).

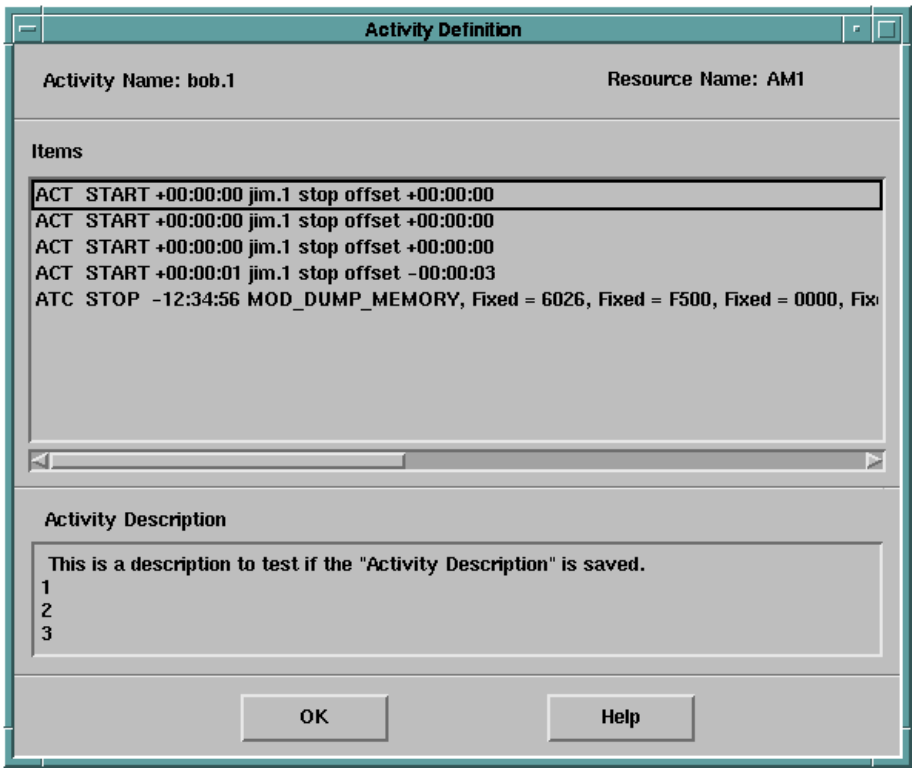


Figure 8.6.1.4-1. Activity/BAP Definition Dialog Box

8.6.2 Editing a Scheduled Activity

After scheduling an activity, you have many ways of editing it unscheduling it, moving it in time or to a different plan, changing information about it, making copies of it, and adding annotations or locks to it.

8.6.2.1 Unscheduling an Activity

You may unschedule an activity using the General Scheduler. You may achieve a similar goal by using the "Cut" functionality of the Timeline.

To unschedule a scheduled activity:

1. Double click the activity on the Timeline. The information for this activity appears in the General Scheduler main window exactly as it had the moment after you originally scheduled the activity.

2. On the General Scheduler, click **Unschedule**. The scheduled activity disappears from the timeline and appears in the Recycler tool (if the Recycler is open on the screen). Refer to paragraph 8.7, "Recycling Activities," to learn how to reschedule unscheduled activities.

8.6.2.2 Modifying a Scheduled Activity

You may modify a scheduled activity, changing any aspect over which you had control when you scheduled it (e.g., start and stop times, Parameters, etc.).

To modify a scheduled activity:

1. On the Timeline tool, double-click on the scheduled activity. The information for this scheduled activity appears in the General Scheduler main window exactly as it was the moment after you originally scheduled it.
2. Alter the start and stop times and/or parameters as you wish, just as if you were scheduling a new activity.
3. Click **Schedule**. The scheduled activity changes to include the new information, and if the start or stop times have changed, the Timeline reflects this.

8.6.2.3 Cutting, Copying, or Pasting a Scheduled Activity

The Timeline tool allows you to cut or copy scheduled activities from one plan and paste them back onto the same or a different plan.

8.6.2.3.1 Cutting a Scheduled Activity

To cut a scheduled activity:

1. On the Timeline window, click on the scheduled activity you wish to cut. Alternatively, click on a mode caused by the scheduled activity. Black handlebars appear at the ends of the rectangle representing the scheduled activity and any mode transitions the scheduled activity causes.
2. From the **Edit** menu or the Tool Bar, select **Cut**. The timeline unschedules the activity and places it into a paste buffer in the event you wish to reschedule the activity back onto the current active plan, or move it to another. The unscheduled activity also appears on the Activity Recycler tool.

NOTE

You can select multiple scheduled activities by holding down the Control key and clicking on each one. If you delete the unscheduled activity from the Activity Recycler, you will no longer be able to paste that activity onto a plan.

8.6.2.3.2 Copying a Scheduled Activity

To copy a scheduling activity:

1. On the Timeline window, click on the scheduled activity you wish to copy. Alternatively, click on a mode caused by the scheduled activity. Black handlebars appear at the ends of the rectangle representing the scheduled activity and any mode transitions the scheduled activity causes.
2. From the **Edit** menu or the Tool Bar, select **Cut**.

8.6.2.3.3 Pasting an Activity onto a Plan

To paste an activity onto a plan:

1. Select the target plan, if it is not the current plan.
2. Click **Paste** on the Timeline's Toolbar or select **Paste** under the Edit menu option. The timeline schedules the activity according to the current scheduling mode (refer to paragraph 8.6.1.2, "Scheduling Modes").

8.6.2.4 Annotating a Scheduled Activity

Using the Timeline tool, you may annotate or add comments to a scheduled activity. Note that Annotation is associated with the only instance of the scheduled activity that you specify it for. Thus, you may specify a different annotation/comment for different scheduled instances of the same activity definition. You may also change an existing annotation. In either case, you must have permission to modify the scheduled activity..

To annotate a scheduled activity:

1. On the Timeline window, click on the scheduled activity you wish to cut. Alternatively, click on a mode caused by the scheduled activity. Black handlebars opens at the ends of the scheduled activity on the timeline's display, as well as at the ends of the activity's mode transitions.
2. Select **Annotate** under the Edit menu option from the Timeline's menu bar. The Annotation dialog box opens (see Figure 8.6.2.4-1). If the scheduled activity has already been annotated, its annotation opens in the Annotation dialog box.
3. Type your comments about the scheduled activity and click **OK** within the Annotation dialog box. The annotation is stored with the scheduled activity, and the Annotation dialog box closes.

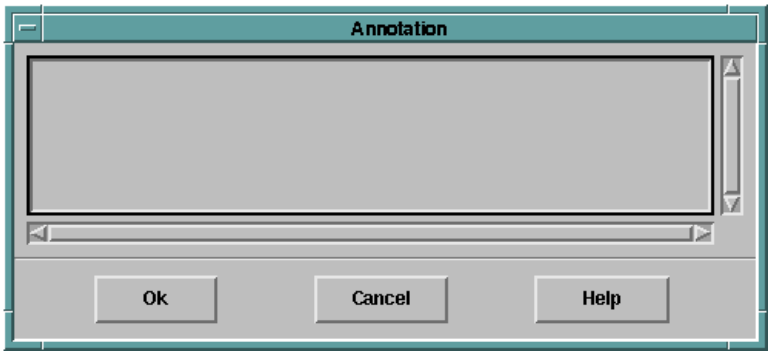


Figure 8.6.2.4-1. Annotation Dialog Box

8.6.2.5 Locking or Unlocking a Scheduled Activity

Use a lock to prevent yourself and other users from accidentally or deliberately changing a scheduled activity. You may not remove or otherwise alter a locked scheduled activity, regardless of whether you have permission on its resource, with the exception of annotating it. The Timeline tool allows you to lock or unlock an activity (which also locks and its associated mode transitions).

To lock/unlock a scheduled activity:

1. On the Timeline window, click on the scheduled activity you wish to lock. Alternatively, click on a mode caused by the scheduled activity. Black handlebars opens at the ends of the scheduled activity on the timeline's display, as well as at the ends of the activity's mode transitions.

2. Select **Lock/Unlock** under the Edit menu option from the Timeline's menu bar or click **Lock/Unlock** on the toolbar. When locking, a lock symbol appears in the upper left corner of the selected scheduled activity, as in Figure 8.6.2.5-1; when unlocking, the lock symbol disappears.

   You can multiply select scheduled activities by holding down the Control key and clicking on each. However, to lock or unlock all selected activities, they must be either all unlocked or all locked, respectively.

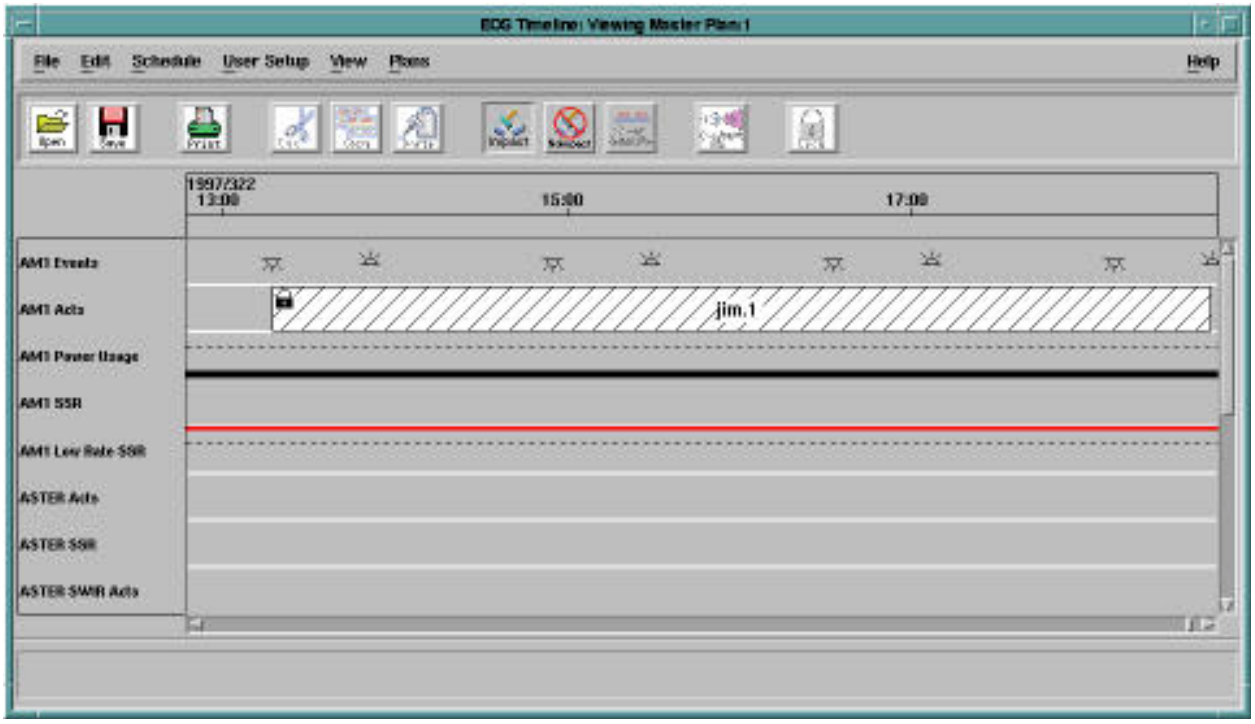


Figure 8.6.2.5-1. Locked Activity Example

8.6.3 Alternatives to Using an Activity Definition for Scheduling

With the General Scheduler you can schedule using a BAP definition, command, or a procedure. Regardless of the original type of the item you use to schedule, once given start and stop times (as by scheduling it), it is referred to as a scheduled "activity," as distinct from an "activity definition."

8.6.3.1 Scheduling a BAP

Using the General Scheduler, you may schedule a BAP from the database in a procedure similar to that of scheduling an activity. As with an activity, you may view a BAP definition before choosing to schedule it. Differences when scheduling with a BAP definition instead of an activity definition include:

1. You must first select BAP from the Filter menu or the tool bar, which displays the BAP definitions from the database.
2. The General Scheduler will schedule repeatedly scheduled activities over the start time/stop time period you specify, according to the BAP definition values as specified in paragraph 8.3.
3. A BAP definition based on orbital events will only produce scheduled activities after its reference time and where FDD data exists.

8.6.3.2 Scheduling a Command

You may place a single command on a schedule without having a predefined activity. This works similarly to scheduling with an activity definition. The command will actually occur at the start time; the stop time simply reserves a period of time over which other activities may not be scheduled (without using oversubscription).

WARNING

Scheduling commands that may cause a mode transition on an instrument or spacecraft subsystem cannot be modeled in the scheduling software since no mode transitions are associated with commands. Modeling includes the power used and any data written to the onboard Solid State Recorder.

To schedule a command:

1. From the General Scheduler Filter menu select **Commands**. Alternatively, click **Cmds...**. Possible commands appear in the Commands list, either for ATC load or ECL, based on the ATC/ECL radio button setting.
2. From the Resource Option menu, select the desired resource. The Commands list displays only commands related to the selected resource.
3. Select either ATC Command or ECL Command as the destination for the command. The Commands list displays only commands of the type you specified.
4. Click the desired command from the Commands list.
5. Select the plan to schedule the activity on from the Open Plans list.

6. Select the scheduling mode. Refer to paragraph 8.6.1.2 for the steps required to set the scheduling mode.

7. Select the start and stop time. Refer to paragraph 8.6.1.1 for the steps required to set the time period the command will be scheduled.

8. Although commands occur instantaneously, you may reserve a period of time after the command, if desired. Enter this period of time in the Duration entry.

9. Select **Schedule** from the Action menu, or alternatively click **Schedule** on the tool bar. The General Scheduler schedules the command as specified. The resulting scheduled activity appears on the display of the Timeline tool, assuming the chosen resource on the selected plan over the selected time range is visible. Figure 8.6.3.2-1 displays an electrical power subsystem command being scheduled on the Master Plan. The command displayed below is scheduled to start on day 12 of 1999 with a duration of 5 minutes.

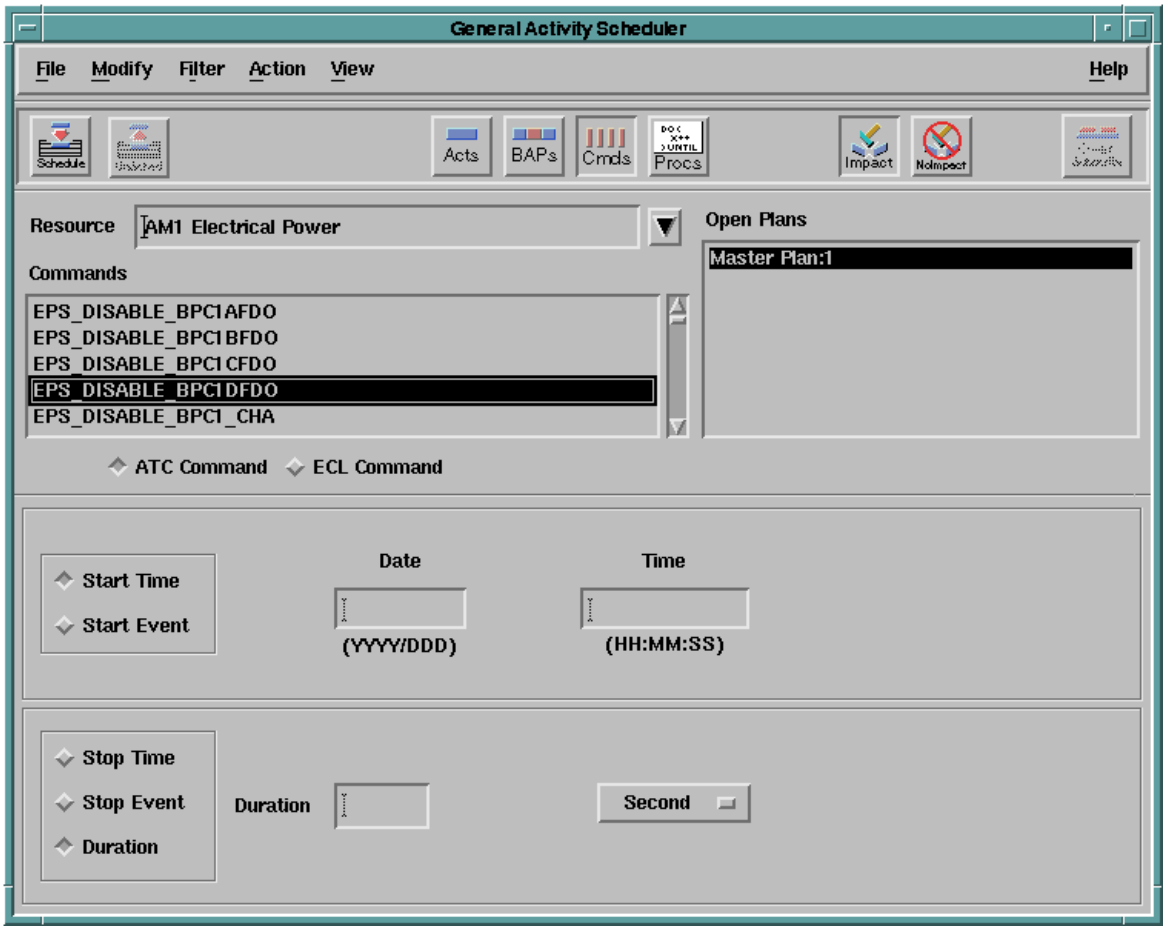


Figure 8.6.3.2-1. Electrical Power Subsystem Command Scheduled on the Master Plan

8.6.3.3 Scheduling a Procedure

You may schedule a Procedure with the General Scheduler in the same manner as scheduling a Command (refer to paragraph 8.6.4.2), except that in step 1 you should select Procedures instead of Commands.

8.6.4 Communications Contact Scheduling

The Communications Contact Scheduler tool appears and acts similar to the General Scheduler, but has additional capabilities to support scheduling communications contacts (individually or by the batch). Please refer to section 8.2.1.2.6 for more information on communications contact activities, and the configuration codes that are part of such activities. The Communications Contact Scheduler allows you to:

1. Schedule an individual TDRSS contact activity.
2. Schedule a batch of TDRSS contacts over a given interval.
3. Schedule an individual ground station contact activity.
4. Submit TDRSS contact times to the NCC.

To start the Communications Contact Scheduler:

1. Click **Tools...** on the Control window. The Tools dialog box opens up.
2. To filter the Scheduling tools only, Select **Planning and Scheduling** from the Tool Type option menu.
3. Select **Communications Contact Scheduler** from the list of Planning and Scheduling tools.
4. Click **OK**. The Tools dialog box closes and the Communications Contact Scheduler starts up.

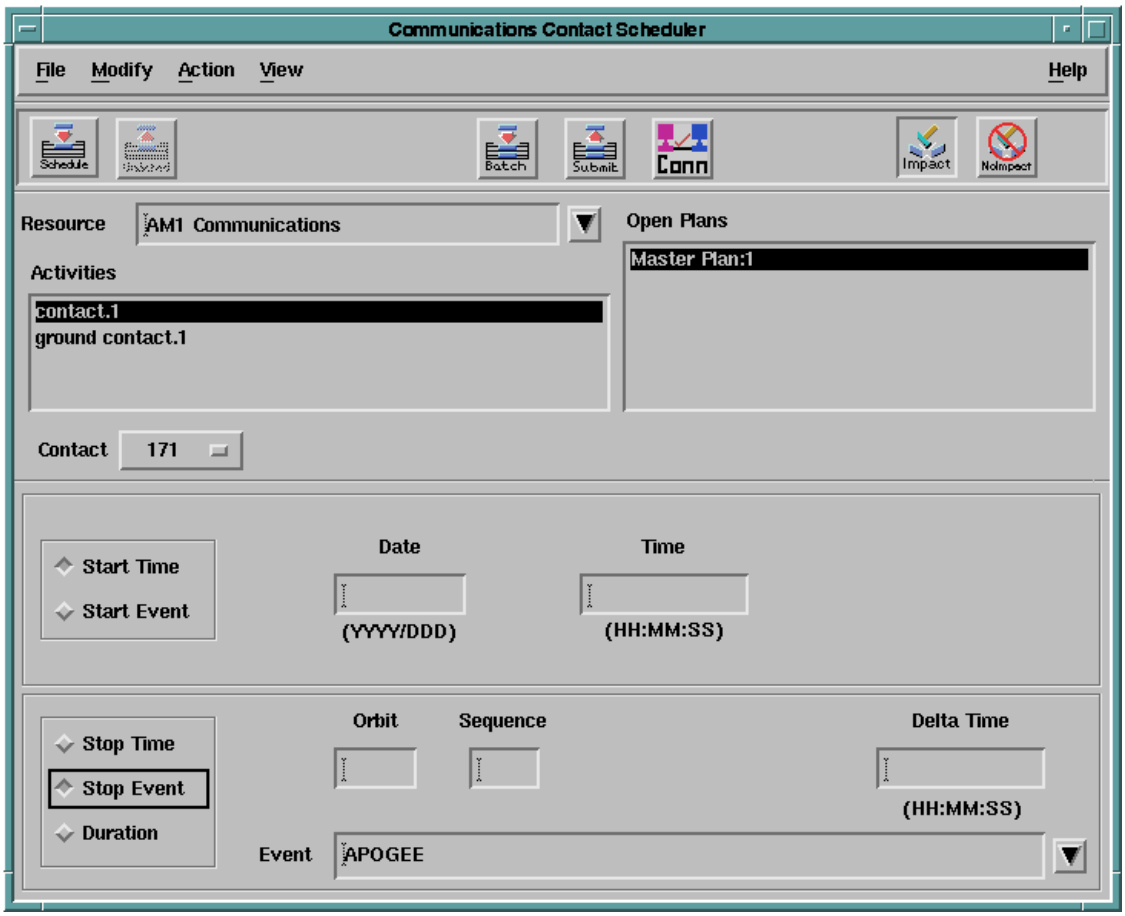


Figure 8.6.4-1. Communications Contact Scheduler Window

Differences between the Communications Contact Scheduler and the General Scheduler include:

1. **Contact resource selection radio box**: When scheduling in non-batch mode, your selection here determines the TDRS or Ground Station resource with which you want to schedule a contact.

2. **Batch mode button**: Depress this to toggle into batch mode, in which the scheduler will invoke a batch scheduling algorithm whenever you press **Schedule**. In batch mode, the start and end times define the entire interval over which you desire to schedule, as opposed to an individual contact's start and end times.

3. **The Modify menu's Contact Algorithm Parameters option**: This brings up a window for changing the parameters used by the batch mode algorithm.

4. **Conn button**: Press this to check with the NCC to make sure the connection exists or to attempt to connect, if required.

5. **Submit button**: Press to submit to the NCC all unsubmitted TDRSS contacts on the currently open plan.

8.6.4.1 Single Contact Scheduling

To schedule a single contact:

1. Select a communications resource, contact activity, and open plan, and enter the start and stop time information.
2. Next, choose the TDRS or Ground Station you wish to contact. When scheduling a TDRSS contact, you must verify the specific TDRS you select is visible over entire period you request.
3. Ensure that the Communications Contact Scheduler is in single scheduling (i.e., not batch) mode, and click **Schedule**. The activity should appear on the timeline, barring any hindrances due to the previous state of the schedule, such as trying to schedule on top of another activity in non-impact mode.

Additional considerations when scheduling TDRSS contacts include:

1. **FDD products**: Both TDRS visibility periods (in-views) and HGA-TDRS gimbal angles come from the FDD products.
2. **TDRS visibility**: The requested TDRS must be visible for the duration of the contact or the scheduler will refuse to schedule the contact.
3. **HGA slews**: If the HGA is not tracking the new contact's requested TDRS for the duration of the requested scheduling contact, the HGA must slew to the correct TDRS to support the contact. If the required slew would require more time than the gap between the contacts, the scheduler will not allow the contact activity to be scheduled.
4. **Prototype Events**: Although coordination of NCC Prototype Events is not provided, you may build complex activities which perform the same function but with added benefits. Please refer to section 8.2.1.2.6. A complex activity, unlike a Prototype Event, is flexible in that you can change the duration and still have all the services be performed properly, and is therefore more useful for contact scheduling. Also, you may view all the services in a complex contact activity on the timeline.

8.6.4.2 Batch Mode Contact Scheduling

The Communications Contact Scheduler provides batch mode scheduling of communications contacts over a time interval via a branch-and-bound algorithm using parameters you enter to determine of how the algorithm will function. The nature of the parameters will become clear only after grasping how the algorithm works.

When you schedule a batch, the scheduler executes the branch-and-bound algorithm once for each contact it puts on the schedule; each time the algorithm produces the best next contact at that point in time, successively doing so until it reaches the end of the scheduling interval. The steps the algorithm takes to discern the best next contact for a schedule in a given state are as follows:

1. Produce a possible schedule by adding to the current schedule a contact in the ideal location, which would be where the contact has optimal separation from the previous contact and optimal duration as specified by the score profiles (the optimal separation and duration are given by the score profiles).
2. Determine this ideal schedule's score using the score profiles and weighting factors.
3. Produce the set of possible schedules created by varying the duration and separation of the contact, determining a score for each (the granularities define how much to vary the duration and separation by each time).
4. Reduce the size of this set by removing schedules whose scores are unacceptably low (what constitutes an unacceptably low score will be defined by the trim value).
5. Repeat the process, starting with step 1, for each possible schedule in our set of schedules, until we have repeated it "enough" (enough is defined by the search depth, which tells the algorithm how many times to repeat, which is to say how many possible contacts to look ahead).
6. Find the best possible schedule in the scenario, pick off the first contact scheduled (the one scheduled the first time we performed step 1), and add it to the real schedule.

Figure 8.6.4.2-1 illustrates a partial search tree built by the branch-and-bound algorithm, showing how the first contact is determined starting with a blank schedule, using a depth of two (looking ahead two contacts). Note how the algorithm prunes a branch on level one and chooses the first contact from the best possible schedule on the second level to be placed on the real schedule.

You may enter parameters affecting the algorithm via the Contact Algorithm Parameters window. To open the Contact Algorithm Parameters window (see Figure 8.6.4.2-2) select **Contact Algorithm Parameters** from the Modify menu.

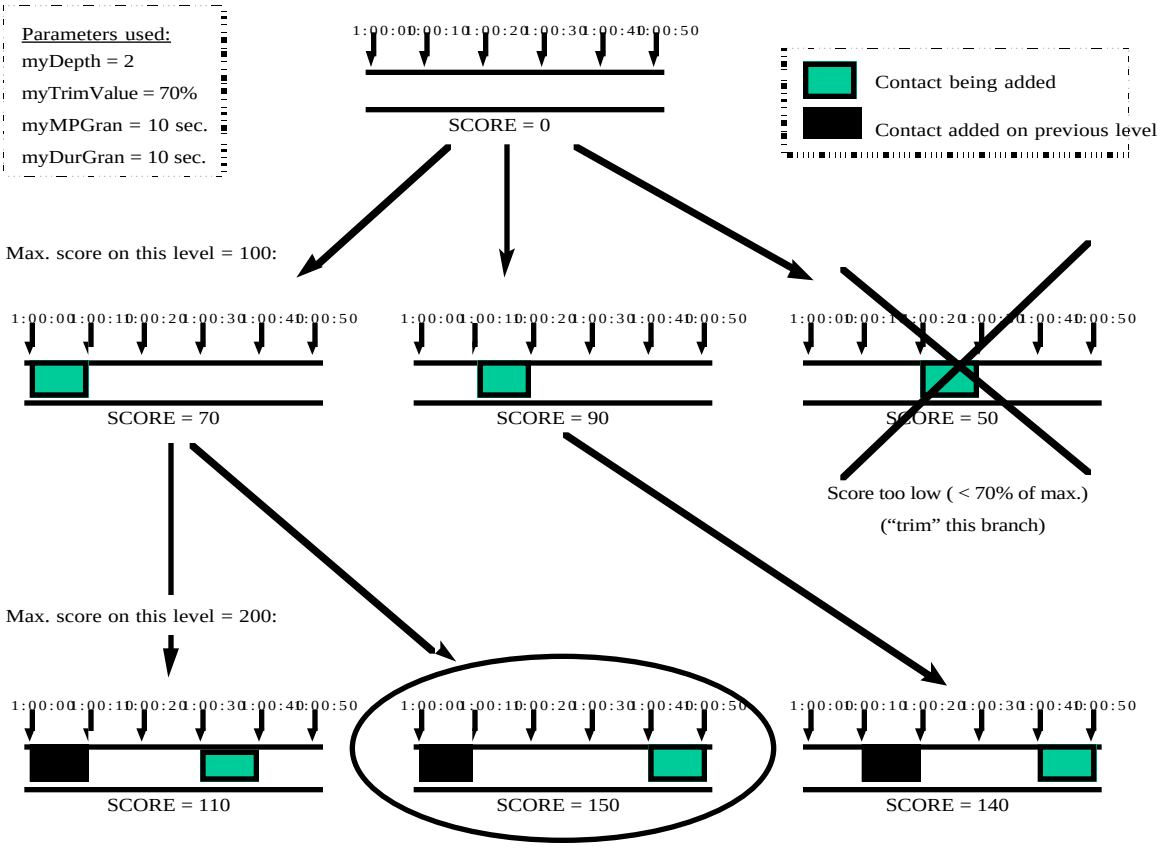


Figure 8.6.4.2-1. Branch-and-Bound Algorithm Example

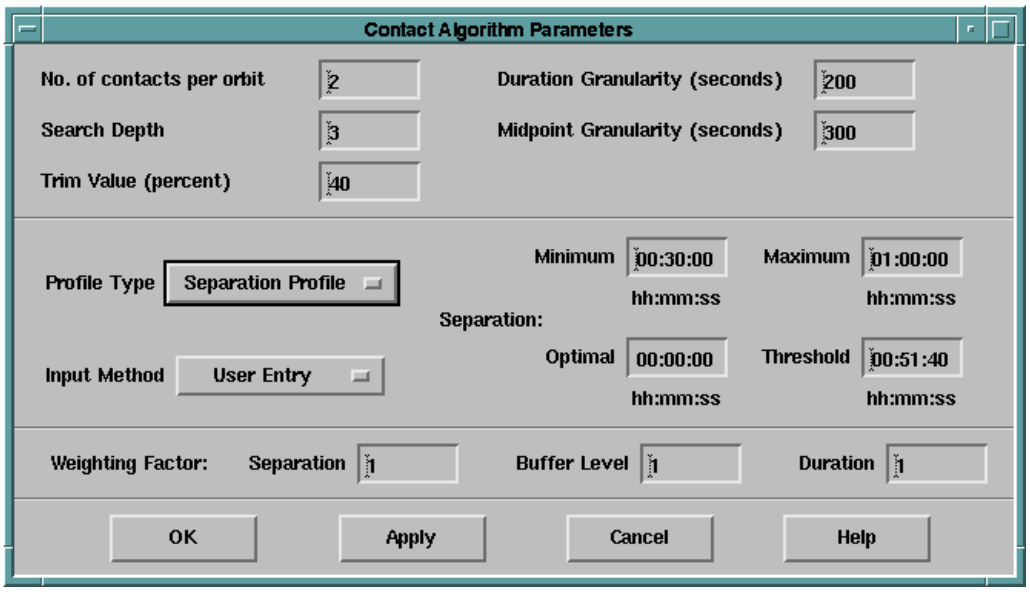


Figure 8.6.4.2-2. Contact Algorithm Parameters Window

Contact algorithm parameters have two purposes: to affect the desired nature of the contacts, and to provide a time-to-run versus schedule optimization. Conceptually, we then have three groups of parameters: those achieving the first goal, those achieving the second goal, and those achieving both simultaneously.

Most likely, after you use a few combinations of inputs, you will find a set of algorithm parameters that provide the best combination of speed and results. After this, you will very seldom need to alter the parameters.

8.6.4.2.1 Contact Algorithm Parameters that Determine the Nature of the Schedule

Parameters defining the desired nature of contacts include:

1. **Number of contacts per orbit**. Defines how many contacts the algorithm should try to schedule each orbit. Typically, though not necessarily, you would enter an integer; the algorithm may schedule just slightly more (perhaps by one percent or less) than the requested number to satisfy latitude walking.

2. **Weighting factor**. Specify to the algorithm which scoring criteria (e.g., duration or separation) to emphasize over others. The factors must be in the range of zero to one. If factors are all equal, all criteria are considered the same amount. Otherwise, the schedule will tend to reflect the criterion with the highest weighting factor. The factors are relative [i.e., dividing them all by two (or any other constant) would not change the nature of the schedule produced by the algorithm].

3. **Latitude walking factor**. Supports the algorithm's feature of scheduling series of contacts with successive latitude offsets, so that the contacts tend to move around the earth

over a few days instead of always occurring at the same spots. The value you specify tells the algorithm how many days it should take for the contacts to get back to their original latitudes.

8.6.4.2.2 Contact Algorithm Parameters that Provide Efficiency Tradeoffs

Parameters providing a time-to-run versus. schedule optimization are meaningful only after understanding how the branch-and-bound algorithm works. The parameters providing a time-to-run versus schedule goodness optimization are:

1. **Search depth**. Tells how many contacts to look ahead when choosing the next best contact. The larger the value, the better expected schedule, but the longer the algorithm will run.

2. **Trim value**. Tells the algorithm how good a possible schedule has to be for the algorithm not to remove it from its set of possibilities. As with search depth, increasing the trim value causes a better expected schedule, but the algorithm will take longer.

3. **Duration Granularity**. Specifies in seconds, by how much to vary the duration when generating possible schedules. The smaller the value, the better the expected result, but the longer the algorithm will run.

4. **Midpoint Granularity**. Specifies in seconds, by how much to vary the midpoint and hence, separation from the previous contact when generating possible schedules. As with duration granularity, decreasing this value produces a better expected schedule, but the algorithm will take longer.

8.6.4.2.3 Contact Algorithm Parameters that Affect Both the Nature of the Schedule and Efficiency Tradeoffs

The score profiles provide both of the previous goals. Each score profile tells the algorithm how to score a contact based on one criterion (e.g., duration or separation). Therefore, varying a score profile changes the size of the algorithm's search space, as well as altering the optimum, minimum, and maximum durations and separations. You may enter each score profile in either of two ways, by user entry on the Contact Algorithm Parameters window or by a configuration file. You specify which way by choosing from the user entry radio box with the following effect:

1. **User Entry.** Provides the simpler and quicker way of entering a score profile. Choose the score profile you wish to enter, and change the minimum, maximum, and optimum values to your satisfaction. For separation, also enter the threshold value, which is the point at which you want the score to start dropping sharply. For duration, enter a delta value defining how far from the optimum (in either direction) you want the score to start dropping off greatly. You cannot directly change the optimal duration, for you define its value when you set the number of contacts per orbit.

2. **Configuration File**. Allows for complex score profiles, such as bell curve approximations, with no limit on the number of data points except for practical considerations such as memory. To create a configuration file, insert a set of points (index, value) into a text file, prefacing them by "x:" and "y:". In the file, the x values typically

stand for time in seconds, and the y values stand for a score, in the range from -1 to 100. A score of -1 means nothing will ever be scheduled beyond that limit. A score of 100 means this is the best possible value you could have. Here is sample configuration file that would yield the same results as if you had used the user entry input method for duration and entered for minimum, maximum, optimum, and delta durations the values 8 minutes, 15 minutes, 10 minutes, and 1 minute, respectively:

x: 479 y: -1

x: 480 y: 0

x: 540 y: 80

x: 600 y: 100

x: 660 y: 80

x: 900 y: 0

x: 901 y: -1

8.6.4.3 The Communications Contact Life Cycle

After scheduling a TDRSS communications contact activity, it appears on the timeline labeled as "Unsubmitted," which means that even though you can see the contact, the NCC as of yet knows nothing about it. You will help the contact activity along through the various stages of its existence until it either becomes a contact confirmed with the NCC or it is deleted from the schedule.

After setting up a group of communications contacts on an open plan exactly as you like, you may ask the NCC to provide these contacts by clicking **Submit** on the Communications Contact Scheduler main window. At this point, assuming the Communications Contact Scheduler is properly connected to the NCC, you will see the contact activities on the timeline change from "Unsubmitted" to "Add pending."

When the NCC responds to accept or reject a contact, the contact changes on the timeline to "Accepted" or "Rejected." Note that the connection from the Communications Contact Scheduler to the NCC is one-way. Messages from the NCC back to the Planning and Scheduling system comes through a background process called the NCC Ingester. The NCC Ingester receives acceptance, confirmation, and rejection messages from the NCC. For more about the NCC Ingester, refer to paragraph 8.12.6.

The various phases through which a TDRSS contact activity may go are:

1. **Unsubmitted**. The contact activity has been scheduled but not submitted to the NCC.
2. **Add Pending**. The contact activity has been submitted to the NCC by sending a Schedule Add Request (SAR), but no response has yet been received.
3. **Add Accepted**. The NCC has accepted the activity by sending a Schedule Result Message (SRM).
4. **Add Rejected**. The contact activity has been rejected by the NCC through an SRM.

5. **Add Confirmed**. The contact activity has been confirmed by the NCC with a User Schedule Message (USM).

6. **Unsubmitted Delete**. A formerly accepted or confirmed contact activity has been deleted but the NCC has not yet been notified.

7. **Delete Pending**. The contact activity has been deleted, and the NCC has been sent notification by a Schedule Delete Request (SDR), but the NCC has not yet confirmed the deletion.

8. **Delete Confirmed**. The NCC has confirmed the deletion of the contact activity via a Schedule Delete Notification (SDN). No information remains for the activity. The timeline displays it only so you can keep track of where you have tried unsuccessfully to schedule contacts.

Special considerations:

1. The contacts that will actually occur are those in the phases "Add Accepted" or "Add Confirmed" once real-life time reaches the start time of the contact.

2. You may not delete a contact activity in either pending phase because you are still awaiting NCC response on your last request for this contact.

3. Deleting a contact activity in the "Add Accepted" or "Add Confirmed" phases causes it to become "Unsubmitted Delete." Deleting it again undoes the previous delete, so it returns to "Add Accepted" or "Add Confirmed."

4. Once a contact is "Delete Confirmed," you may remove it from the schedule and have it completely disappear from the timeline. The only other phase from which you can do this is "Unsubmitted."

8.6.5 Uplink Load Scheduling

The Load Scheduler Tool provides the capability to schedule uplinks for the spacecraft and instrument loads, including instrument microprocessor loads, flight software loads, table loads, and RTS loads. ATC Loads are NOT scheduled with this tool, as they are scheduled automatically as part of the DAS Generation Process. This Load Scheduler (see Figure 8.6.5-1) is started by clicking **Schedule** on any Load Builder tool. The window allows you to enter an uplink activity, an uplink interval, and a number of tries.

The tool looks for confirmed communication contacts within that interval, and schedules the uplink activities. If the number of tries is more than one, all subsequent attempts are treated as contingency. This tool uses a first-fit algorithm, meaning that uplinks will be scheduled on the first N contact within the uplink window, that is long enough for support.

This tool operates similarly to the General Scheduler, with the following exceptions: there is an additional panel in the window where load information is displayed and entered; only uplink resources are displayed; and the window is used to schedule a single load.

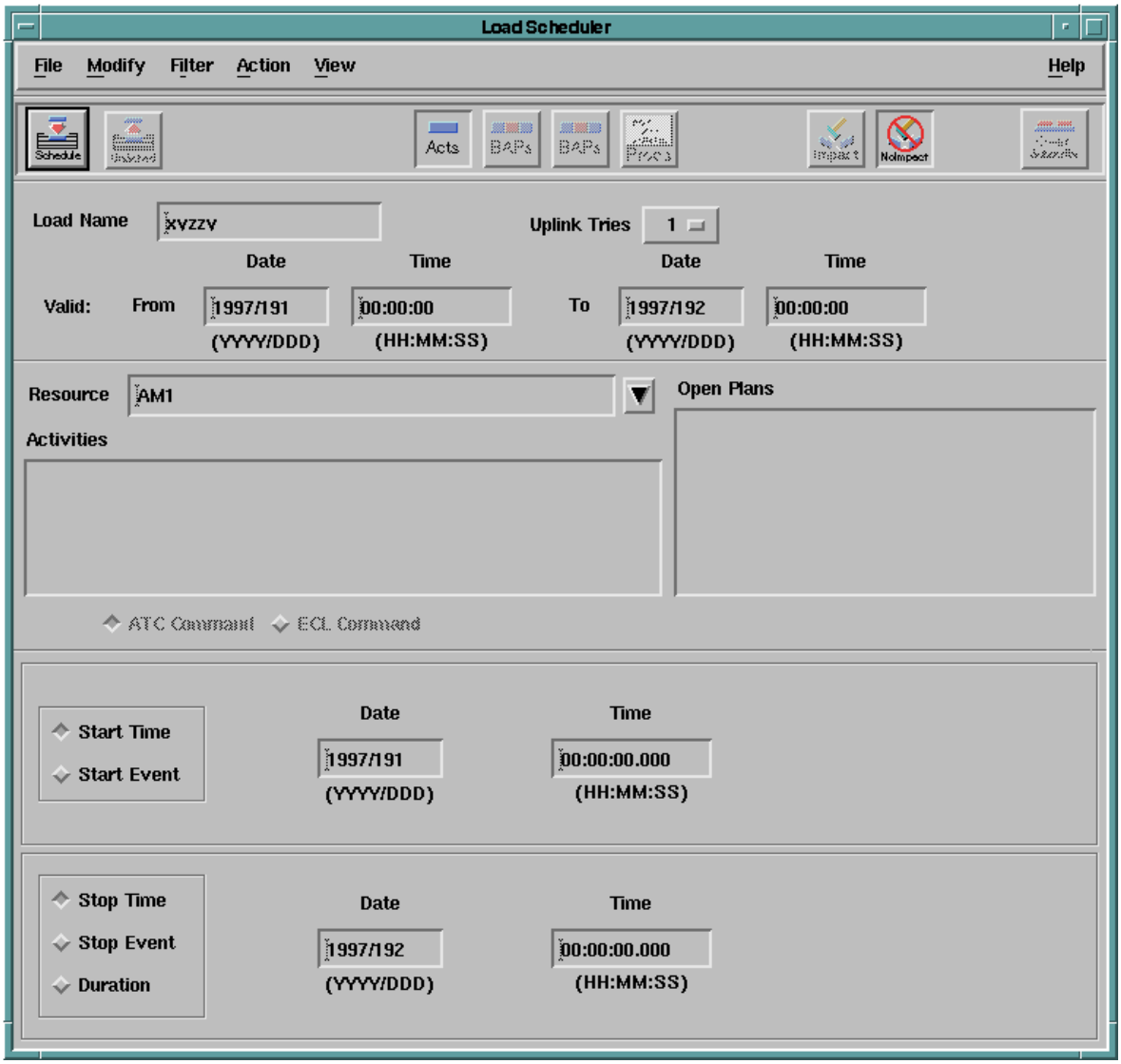


Figure 8.6.5-1. Load Scheduler Window

8.6.5.1 Uplink Activity Definitions

Before scheduling the uplink of a load, you must first define an uplink activity. Uplink activity contains specification of the uplink data rate during the pass. Each uplink activity must have a mode transition for the load resource offset from the start. The uplink data rate for this mode must be greater than 0. This uplink data rate should be the actual data rate of the procedure, including all error corrections. This data rate is used to calculate the duration of the activity, based on the load size. There must also be a mode transition, offset from the stop time of the activity that returns the load resource to a zero uplink data rate mode.

The special symbols listed in Table 8.6.5.1-1 can be used to pass uplink information into ECL Directives when defining of uplink activities. When the activity is scheduled, these symbols will be replaced by their respective values.

Table 8.6.5.1-1. ECL Uplink Directive Parameters

Symbol	Type	Substitution
_LOADNAME	string	The name of the load being scheduled
_PARTITIONS	integer	The number of partitions in the load
_VALIDSTART	date/time	The start of the valid uplink period
_VALIDSTOP	date/time	The end of the valid uplink period
_TRY	integer	The attempt number
_NUMTRIES	integer	The total number of attempts

This is a sample uplink activity definition:

START +00:00:00 Mode Uplink

START +00:00:00 START UPLINKRTS(_LOADNAME, _PARTITIONS, _TRY)

STOP +00:00:00 Mode Idle

8.6.5.2 Scheduling an Uplink of Load

1. Click **Schedule** on any Load Builder Tool after generating the load. This opens the Load Scheduler window. The load name and valid uplink interval are displayed in read-only mode.
2. Select an open plan to schedule (if a plan is not open, you must first open a plan using the Timeline tool).
3. Select an uplink resource.
4. Select an uplink activity.
5. Use the option menu to enter the number of tries (1, 2, or 3).
6. Enter the desired uplink interval. It must be within the valid interval.
7. Click **Schedule**. A dialog box opens stating when the activity(s) are scheduled, or if the attempt fails.

8.6.6 Rescheduling Deleted Activities

Unscheduled activities, previously scheduled activities that were removed from a plan using one of the Planning and Scheduling subsystem scheduling tools, are collected in the Activity Recycler. The Activity Recycler allows you to view more information about an unscheduled activity, re-schedule an unscheduled activity, or delete an unscheduled activity. The Activity Recycler provides a list of the unscheduled activities, and a set of filters allowing you to control which unscheduled activities you see in the list.

To start the Activity Recycler:

1. Click **Tools...** on the Control window. The Tools dialog box opens up.
2. To filter the Scheduling tools only, Select **Planning and Scheduling** from the Tool Type option menu.
3. Select **Activity Recycler** from the list of Planning and Scheduling tools.
4. Click **OK**. The Tools dialog box closes and the Activity Recycler starts up (see Figure 8.6.6-1).

The Activity Recycler toolbar contains two sets of push buttons. The first four, from left to right, are:

1. Re-schedule and Unscheduled activity**.**
2. View details of an unscheduled activity.

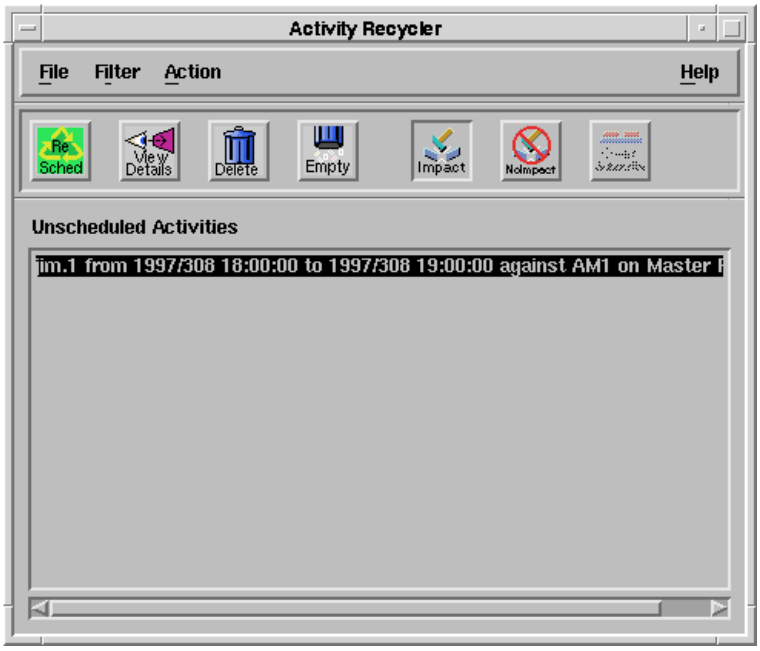


Figure 8.6.6-1. Activity Recycler Window

3. Delete an unscheduled activity.
4. Empty the Recycler (delete all displayed unscheduled activities).

The next set of three icons are for selecting the scheduling mode. Below the tool bar is the filtered list of unscheduled activities. The unscheduled activities are presented in the form:

<actname> from **<starttime>** to **<stoptime>** against **<resourcename>** on **<planname>**

Where **<actname>** is the name of the unscheduled activity, **<starttime>** is the time at which the unscheduled activity started, **<stoptime>** is the time at which the unscheduled activity ended, **<resourcename>** is the name of the resource the unscheduled activity was scheduled on, and **<planname>** is the name of the plan that the unscheduled activity was scheduled on.

8.6.6.1 Filtering Activities

To help keep the number of unscheduled activities displayed in the Activity Recycler manageable, four different filters are available. These filters allow you to display a subset of the unscheduled activities based on:

1. What activity definition the unscheduled activity was scheduled from (Refer to paragraph 8.6.6.1.1).
2. What plan the unscheduled activity was scheduled on (Refer to paragraph 8.6.6.1.2).
3. What resource the unscheduled activity was scheduled on (Refer to paragraph 8.6.6.1.3).
4. At what times the unscheduled activity was scheduled for (Refer to paragraph 8.6.6.1.4).

To select a filter, click on the Filter menu, and then select the filter you wish to edit. If you wish to edit several of the filters, click **All…** to open all of the filter dialog boxes. Only the unscheduled activities that pass through all of the filters will be displayed in the list of unscheduled activities.

Once all the filters have been configured to your liking (see paragraphs below for instructions on how to configure the filters), you may save this configuration for use in the future, as follows:

1. Click on the Filter menu.
2. Select the **Save Filters…** option. The Save Filters dialog box opens.
3. Type in the path and filename that you would like to save the configuration to.
4. Click **OK.** The configuration will be saved.

To re-load this configuration in the future:

1. Click on the Filter menu.
2. Select the **Load Filters…** option. The Load Filters dialog box opens.
3. Type in the path and filename for the saved configuration.
4. Click **OK**. The configuration is loaded.

8.6.6.1.1 Filtering by Activity Name

The activity filter of the Activity Recycler allows you to filter the displayed unscheduled activities by the name of the activity definition the unscheduled activity was scheduled from.

To use the Activity filter

1. Select **Activity…** from the File menu on the Activity Recycler window. The Activity Recycler Activity Filter dialog box opens with the current filter configuration displayed (see Figure 8.6.6.1.1-1).

The list on the left of the filter is the available activities list. This list contains the names of all activity definitions in the system. The list on the right is the selected activities list. This list contains the names of all activity definitions that will pass through this filter. To select items from these lists, click on them with the left mouse button. You may also click and drag to select several items from the list. Holding down the control key will allow you to select more than one contiguous group of items. The column of buttons between the two lists is for manipulating the list of selected activities.

2. Click the **Add** button to add the highlighted items from the available list to the selected list, and the **Remove** button to remove the highlighted items from the selected list.
3. Click the **Replace** button to remove any items that are highlighted in the selected list, and then add any items that are highlighted in the available list to the selected list.
4. Click the **Clear** button to remove all of the items from the selected list.
5. To filter the unscheduled activities by activity name, place the activity definition names that you wish to pass through this filter into the selected list, and then click APPLY.
6. If you do not want to filter by activity name (that is, you want unscheduled activities with any name to be displayed), clear the selected list and then click APPLY.
7. Click **OK**.

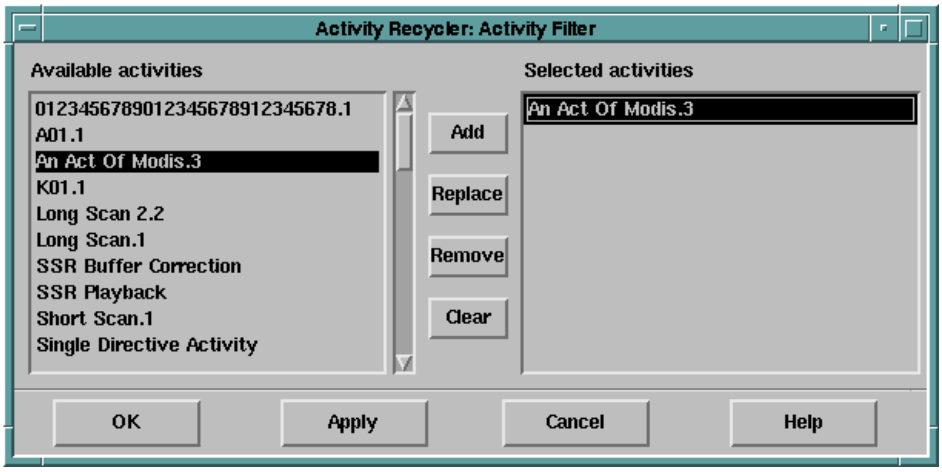


Figure 8.6.6.1.1-1. Activity Recycler Activity Filter Dialog Box

8.6.6.1.2 Filtering by Plan Name

The Plan filter of the Activity Recycler allows you to filter the displayed unscheduled activities by the name of the plan that the unscheduled activity was unscheduled from.

To use the Plan filter

1. Select **Plan…** from the File menu on the Activity Recycler window.

The Activity Recycler Plan Filter dialog box opens with the current filter configuration displayed (see Figure 8.6.6.1.2-1).

The list on the left of the filter is the available plans list. This list contains the names of all currently open plans in the system. The list on the right is the selected plans list. This list contains the names of the open plans that an unscheduled activity must have previously been scheduled on to pass through this filter. To select items from these lists, click on them with the left mouse button. You may also click and drag to select several items from the list. Holding down the control key will allow you to select more than one contiguous group of items.

Follow the steps 2 through 7 in the section 8.6.6.1.1 above to select the list of plans in the Plans filter.

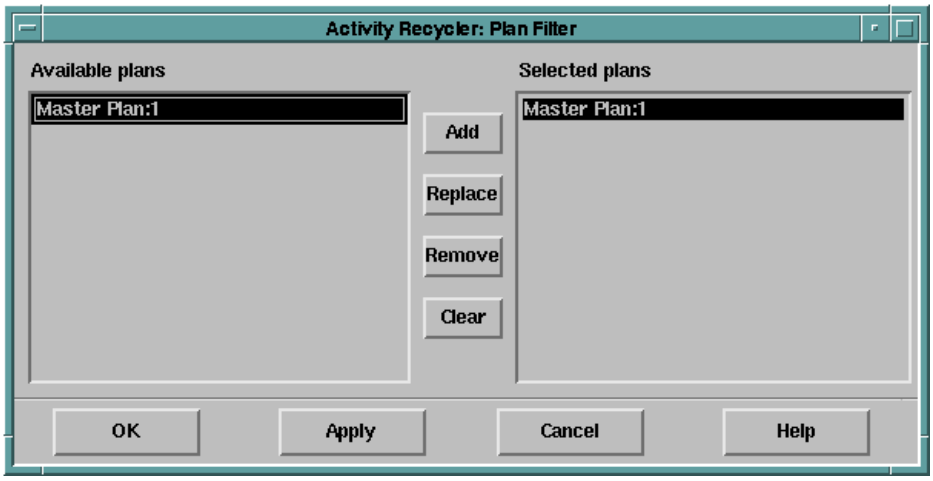


Figure 8.6.6.1.2-1. Activity Recycler Plan Filter Dialog Box

8.6.6.1.3 Filtering by Resource Name

The Resource filter of the Activity Recycler allows you to filter the displayed unscheduled activities by the name of the resource that the unscheduled activity was scheduled on.

To use the Resource filter

Select **Resource…** from the File menu on the Activity Recycler window. The Activity Recycler Resource Filter dialog box opens with the current filter configuration displayed (see Figure 8.6.6.1.3-1).

The list on the left of the filter is the available resources list. This list contains the names of all resources in the system. The list on the left is the selected resources list. This list contains the names of the resources that an unscheduled activity must have been scheduled against to pass through this filter. To select items from these lists, click on them with the left mouse button. You may also click and drag to select several items from the list. Holding down the control key will allow you to select more than one contiguous group of items.

Follow the steps 2 through 7 in the section 8.6.6.1.1 above to select the list of resources in the Resource filter.

Figure 8.6.6.1.3-1. Activity Recycler Resource Filter

8.6.6.1.4 Filtering by Time Interval

The Time filter of the Activity Recycler allows you to filter the displayed unscheduled activities by the time interval over which they were originally scheduled.

To use the Resource filter

Select **Time…** from the File menu on the Activity Recycler window. The Activity Recycler Time Filter dialog box opens with the current filter configuration displayed (see Figure 8.6.6.1.3-1).

The time filter provides areas for you to enter a start and stop time that define an interval. The entry fields next to “From” allow you to enter a date and time for the start of the interval you are defining, and the entry fields next to “To” allow you to enter a date and time for the end of the interval you are defining. To enter these times, click in the appropriate text entry field, then enter the date or time according to the format shown below the entry field.

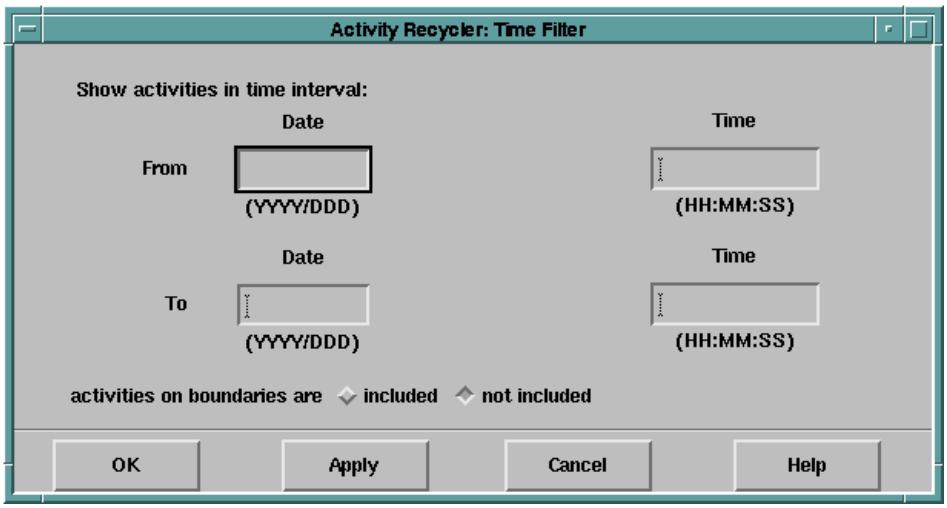


Figure 8.6.6.1.4-1. Activity Recycler Time Filter

The radio buttons on the bottom of the time filter allow you to select whether or not the time interval you are filtering by should be inclusive. To include only those activities whose scheduled intervals are fully contained within the interval defined for the filter, select the "activities on boundaries are not included" option. To allow activities whose scheduled intervals are not fully contained within the interval defined for the filter, but that overlap it, select the "activities on boundaries are included" option.

To filter the unscheduled activities by time interval, enter the start and stop times for the interval you want to be passed through this filter, select whether or not you want the interval to be inclusive, and Click the **APPLY** button. If you do not want to filter by time interval (that is, you want unscheduled activities that were originally scheduled to occur at any time to be displayed), clear the time entries in the "From" and "To" fields and Click the **APPLY** button.

8.6.6.2 Viewing Activities

The unscheduled activities list on the Activity Recycler main window provides summarized information for the unscheduled activities that pass through the filters. The information is presented in the form:

<**actname**> from <**starttime**> to <**stoptime**> against <**resourcename**> on <**planname**>.

Where <**actname**> is the name of the unscheduled activity, <**starttime**> is the time at which the unscheduled activity started, <**stoptime**> is the time at which the unscheduled activity ended, <**resourcename**> is the name of the resource the unscheduled activity was scheduled on, and <**planname**> is the name of the plan that the unscheduled activity was scheduled on.

To see more information concerning the unscheduled activity, you can use the view activity details ability of the Activity Recycler. First, start the General Scheduler if it is not already running. Click on the unscheduled activity you wish to see more information about, then either click **View**

Details in the toolbar, or select **View Details...** from the Action menu. The activity you selected and all its associated information is shown on the General Scheduler.

8.6.6.3 Rescheduling Activities

The Activity Recycler allows you to place unscheduled activities back on the schedule. There are two methods for rescheduling, directly from the Activity Recycler, and indirectly through the General Scheduler.

To reschedule directly from the Activity Recycler using the original parameters for unscheduled activities:

1. Select the activities you want to reschedule from the Unscheduled Activities list. Click on an unselected activity to select it. Click on a selected activity again to deselect it.
2. Once the activities you wish to reschedule are selected, use the scheduling mode buttons in the toolbar to select the scheduling mode.
3. Click **Reschedule** or select **Reschedule** from the Action menu.

If you want to change any information associated with an unscheduled activity before rescheduling it, you must do so indirectly through the General Scheduler. View the activity as described in paragraph 8.6.6.2. Using the General Scheduler, you may now modify the activity and reschedule it.

8.6.7 Deleting Activities

The Activity Recycler allows you to delete unscheduled activities. Be cautious, deleting an unscheduled activity is irreversible. Once deleted you cannot get an unscheduled activity back. It should also be noted that if you are in the middle of a cut and paste from the Timeline and you delete some of the unscheduled activities involved, the Timeline will not be able to paste those unscheduled activities back into the schedule.

With the above cautions in mind, to delete unscheduled activities, select the unscheduled activities you want to delete from the Unscheduled Activities list. Click on an unselected, unscheduled activity to select it. Click on a selected, unscheduled activity again to de-select it. Once the unscheduled activities you wish to delete are selected, click **Delete** in the toolbar, or click on the **Action** menu and select the **Delete** option. The selected unscheduled activities will be deleted and removed from the Recycler.

To delete all of the displayed unscheduled activities, use the empty function of the Activity Recycler. This is a quick way to delete a large number of unscheduled activities at the same time. Configure the Activity Recycler's filters so that only the unscheduled activities you want to delete are displayed (Refer to paragraph 8.6.6.1 for information on how to configure the Activity Recycler's filters). Click **Empty** in the toolbar, or select **Empty** from the Action menu. All of the displayed unscheduled activities will be deleted.

8.7 ASTER Filter

The ASTER Filter is a background process responsible for receiving and processing planning and scheduling messages from the ASTER Ground Station (AGS) AOS. Scheduling messages include activity lists referred to as Short Term Schedules (STS) or One Day Schedules (ODS). STSs and ODSs may be scheduled either on the Master Plan, from which a load will be generated, or on a What-if Plan. Schedule messages destined for a What-if Plan will be referred to as Analysis Mode schedules.

In response to an STS, the ASTER Filter will produce a Preliminary Resource Schedule. In response to an ODS, it will produce an Activity Schedule. Finally, a scheduling message may be a request for EOC Schedules. The ASTER Filter also transmits the DAS back to the ASTER AGS when it is generated. For more information about the data exchange between ASTER AOS and the FOS, refer to the ICD between ECS and the ASTER AGS.

8.7.1 ASTER Polling Process

A polling process will automatically trigger the ASTER Filter to begin processing an incoming file.

To start the ASTER filter poller:

1. At the Control window, click **Tools...**. The Tools dialog box opens.
2. Select **PAS** as the Tool Type.
3. Select **ASTER Filter** from the list of Planning and Scheduling tools.
4. Click **OK**.

The Tools dialog box will close and the ASTER Filter poller will begin executing in the background. It will poll a predetermined for an incoming Short Term Schedule, One Day Schedule, or an EOC Schedule Request file. The polling interval for checking files in the directory is nnn seconds. File transfers are described in more detail in the ASTER ICD. When one of the files is found, the poller will spawn the ASTER Filter process which will validate and schedule the activities included in the file.

8.7.2 Scheduling a Short Term Schedule

An STS consists of ASTER activity scheduling requests used in planning for AM-1 spacecraft resources and TDRSS contact times. Short Term Schedules are automatically processed, and activities within schedules are entered on the Master Plan. After scheduling is completed, the Preliminary Resource Schedule, containing all spacecraft subsystem and other instrument activities, will be written to a file and sent to the ASTER AGS. The format of this data is as specified in the ASTER ICD.

8.7.3 Processing an Analysis Mode STS

An Analysis STS is processed by the ASTER Filter in the same way as an STS destined for the Master Plan. However, activity requests in an Analysis STS are scheduled on a what-if plan rather than the Master Plan. When an Analysis STS is received, the ASTER Filter recognizes that the

request is for analysis scheduling. The ASTER Filter copies the affected portion of the Master Plan to a What-if Plan and schedules the ingested activity list on the What-if Plan, leaving the Master Plan unaffected. Results will be returned in the Analysis Preliminary Resource Schedule. The What-if Plan created within the Planning and Scheduling system is named WHATIFyyyydddnnn. The year (yyyy), day of year day (ddd) and unique number (nnn) portion of the what-if name corresponds to the analysis mode ODS name as defined in the ASTER ICD.

8.7.4 Scheduling a One Day Schedule

An ODS consists of ASTER activity scheduling requests used in planning for AM-1 spacecraft resources and TDRSS contact times. An ODS will contain the same information as an STS; however, the ODS will presumably contain scheduling requests thought to be much more accurate than those in the STS. An ODS also contains scheduling requests for a shorter period of time (~24 hours) than the STS (~30 days). An ODS is processed automatically and the activities within it are scheduled on the Master Plan. After scheduling is completed, the Activity Schedule, containing all spacecraft subsystem and other instrument activities, will be written to a file and sent to the ASTER AGS. The format of this data is as specified in the ASTER ICD.

8.7.5 Processing a Late Change

If the ASTER AOS wishes to schedule activities within the portion of the schedule for which a command load has already been generated, its request will be processed as a late change. If an ODS is received that contains activity scheduling requests falling within the late change period of the schedule, the requests will be scheduled on a What-if Plan. An event message will be generated indicating that a late change from ASTER has been received, and the ODS file will be transferred to a directory at the EOC. The affected portion of the Master Plan is copied to the What-if Plan, and then the activities in the ODS are scheduled on the what-if plan. The FOT, upon receiving the event message, should look at the newly generated What-if plan, and check for constraints as well as operational issues. If no constraints are found on the What-if Plan, and if the FOT decides to incorporate the ASTER late changes into the Master Plan, the FOT will need to unlock the Master Plan. The FOT will then run the ASTER Filter tool locally using a local script and specifying the name of the ODS file corresponding to the late change. This script is called st_fs and is located under the directory designated by the environment variable STARTUPFILELOC. This script will write the polling signal file so the ASTER filter at the EOC will process the ODS file. Since the original schedule was processed constraint-free on a What-if Plan, the new schedule will be able to be incorporated on the Master Plan constraint-free. This late change sequence prevents last minute constraints from occurring on the Master Plan. Results will be returned in the Activity Schedule.

For late changes resulting in constraints to the What-if Plan, the FOT will have to notify the ASTER AGS to revise the schedule before resending it as a late change. FOT will then need to regenerate the DAS to reflect the late change.

8.7.6 Processing an Analysis Mode ODS

An Analysis Mode ODS is processed by the ASTER Filter in the same way as an ODS destined for the Master Plan. However, activity requests in the Analysis ODS are scheduled on a What-if Plan

rather than the Master Plan. When an Analysis ODS is received, the ASTER Filter recognizes that the request is for analysis scheduling. The ASTER Filter copies the affected portion of the Master Plan to a What-if Plan and schedules the ingested activity list on the What-if Plan, leaving the Master Plan unaffected. Results will be returned in the Analysis Activity Schedule.

8.7.7 Requesting a Portion of the Master Schedule

The ASTER Filter can also be used to view a portion of the Master Plan without scheduling any activities by sending a Request for EOC Schedules. When the ASTER Filter ingests a Request for EOC Schedules file containing a request for a portion of the plan between a given start and stop time, it generates an Activity Schedule showing each activity scheduled on all spacecraft subsystems and all instruments between the given start and stop times. This Activity Schedule will then be sent to the ASTER AGS.

8.7.8 Report Detailed Activity Schedule (DAS) Generation

When a DAS is generated against the Master Plan using the Planning and Scheduling Load Generator tool, the Aster Filter is notified. Upon notification, the Aster Filter sends an Activity Schedule to the ASTER AGS that spans over the same time period as the DAS. The Activity Schedule will contain activities scheduled on all of the spacecraft subsystems and all instruments for this time period.

8.8 Generating Loads

There are four graphical tools used to generate loads for the AM-1 Mission. These tools are the Load Generator tool, RTS Load Builder tool, Table Load Builder tool, and the Binary Load Builder tool. The Load Generator is used to generate ATC loads and update the ground script based on a DAS. The RTS Load Builder is used to validate, build, and schedule RTS loads. The Table Load Builder is used to validate, build, and schedule spacecraft table loads. The Binary Load Builder is used to build and schedule flight software and microprocessor loads. All of these tools are accessible via the Control window. When a load is generated, the load contents file is packetized and partitioned into appropriate sized loads. Each load partition will have the appropriate load initiate command. The load partitions will be saved to file and a load catalog entry will be created for the entire load. The load catalog is used to keep track of all CMS processed loads for the spacecraft.

8.8.1 Generating ATC Loads

A DAS consists of activities scheduled on a portion of the Master Plan, generally 24 hours of scheduled activities and events. The Load Generator tool provides the capability to generate a DAS for a specified duration. During load generation, activities within the specified portion of the Master Plan are frozen to allow no further schedule changes. Next, the schedule is checked for activity and command level constraint violations. Soft constraint violations must be approved by the FOT before a DAS can be generated. A schedule with hard constraints cannot be made into a DAS. Once the DAS is hard constraint free and all soft constraints have been corrected or approved for the activities, then the DAS is submitted for the generation of the ATC load and ground script. The DAS is expanded into a command list. The command binary is built and the

command list is command-level constraint checked. If a single hard command-level constraint is found, the ATC load and ground script generation is ceased. The entire list of constraint violations (hard and soft) are reported to the user via the Load Generator Tool. If only soft constraints are found the soft constraint violations are reported to the user via the Load Generator Tool. The user must review all of the constraints and either accept them all or reject then all. Accepting the soft constraint violations means that the ATC load and ground script may be generated with the existing violations. Rejecting the violations indicates that the violations need to be resolved before ATC load and ground script generation may continue.

ATC loads are automatically partitioned. The partitioning is based on the number of available command buffer locations and wrapping in the buffer. The safing commands are automatically appended to the end of each partition. This is taken into consideration when determining the number of available locations. There is a configuration file, , found in $CONFIG_DIR… After the ATC load is generated , the uplink of the ATC Load partitions is then automatically scheduled.

Jobs submitted through the Load Generator tool are processed on the EOC Data server. There is a single queue for all requests; late change DAS/ATC load generation and constraint checking. Entries are automatically prioritized, late changes first, then DAS generation and lastly constraint checks. Activity level-only constraint checks can be performed on the userstation and do not require the Data server. Table 8.8.1-1 lists the possible status of jobs created by load generation.

Only designated FOT members are allowed to submit DAS's and late changes. All FOT and IST users can perform constraint checks.

Table 8.8.1-1. Load Generation Status Messages

State	Meaning
Initializing	Waiting to request schedule from resource model
Reading	Reading schedule from resource model
Waiting	In queue, waiting to send for ATC load generation or constraint
Processing	Check processing is being processed request
Completed	Completed with no constraint violations (or with approved soft constraint violations)
Pending	Completed with only soft constraint violations. Process completion is waiting for approval or disapproval before proceeding
Failed	Completed with a hard constraint violation. You must unlock part of the plan, resolve the conflict and resubmit the DAS
Reconnecting	Lost connection with Command Management, Attempting to reconnect
Deleting	Job marked for Deletion, waiting for Delete request to finish
Deleted	Job was Deleted

To start the Load Generator:

1. Click **Tools...** on the Control window.

The Tools dialog box opens up.

2. To filter the Scheduling tools only, Select **Planning and Scheduling** from the Tool Type option menu.
3. Select **Load Generator** from the list of Planning and Scheduling tools.
4. Click **OK**.

The Tools dialog box closes and the Load Generator starts up.

8.8.1.1 Request for a Detailed Activity Schedule

An ATC load is generated based on the DAS. A DAS is a collection of activities over a selected time period, nominally 24 hours.

The Load Generator tool is used to select the DAS for ATC load generation.

When the DAS is selected for ATC load generation, it is automatically activity-level and command-level constraint checked.

The DAS is submitted to Command Management for ATC load generation. This automatically causes a number of functionalities to be invoked. The DAS is expanded into a list of commands. From the expanded list, an ATC load is generated and the Ground Schedule is updated. The ATC load generation produces a Load Report, and the uplink image file. The Load Report is accessible from the Report Browser. In addition to the Load Report, and Integrated Report is also generated. This report contains ATC load commands, ground commands, and ECC directives. The image file is used to update the ATC ground image once the ATC load uplink notification is received.

The Ground Schedule is used to produce Ground Script. Ground Script consists of planned ground commands and directives expanded from the activities in the DAS and executed in real-time.

To request DAS generation:

1. Click **DAS** on the Load Generator window.
2. Select **Master Plan**.

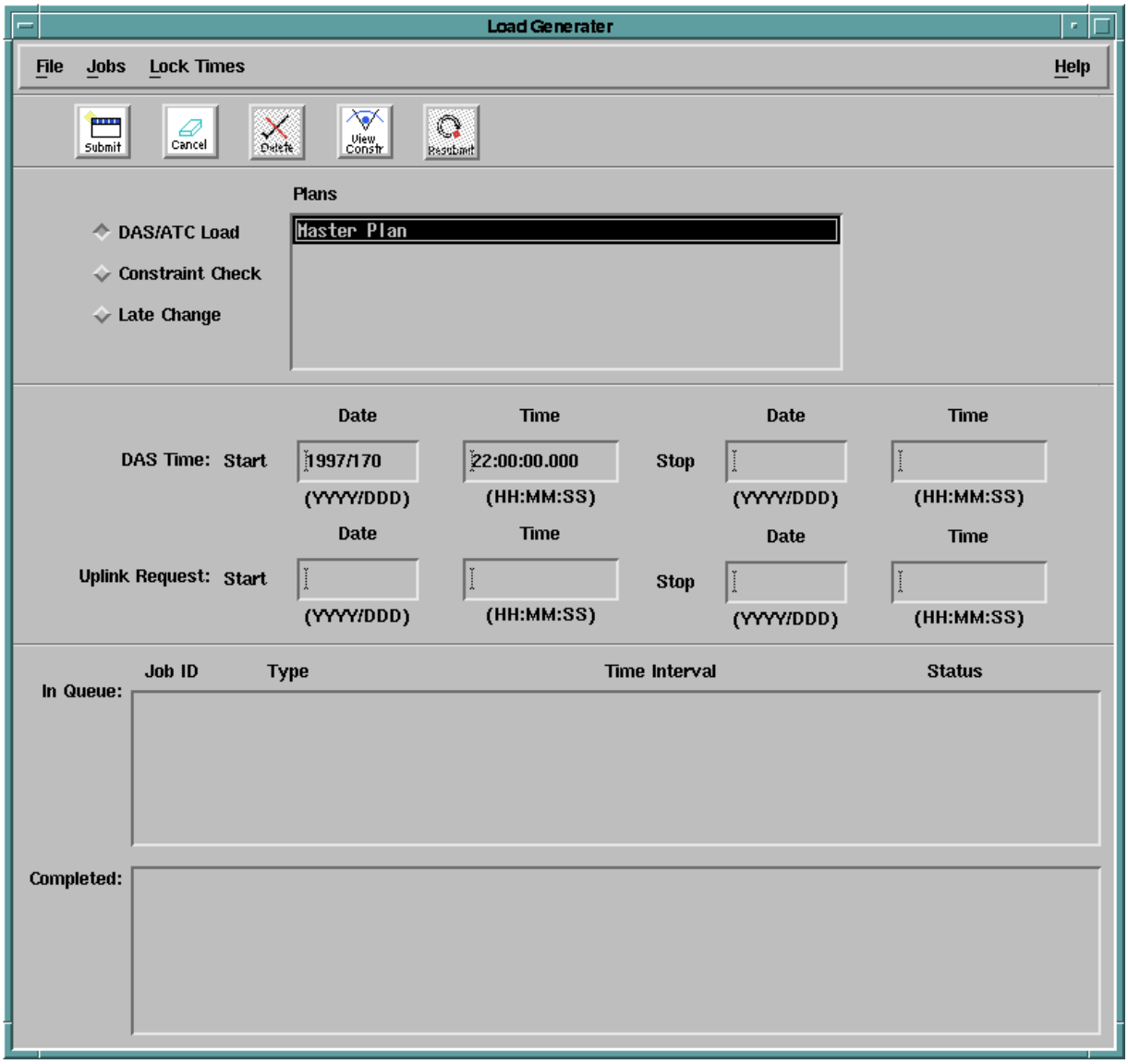


Figure 8.8.1.1-1. Load Generator DAS Window

3. Under normal operations, the DAS start time will be filled in with the end time of the previous DAS.
4. Enter the stop time for the DAS in the DAS stop text field.
5. Enter the desired uplink interval for the generated ATC Load.
6. Click **Submit**.

8.8.1.2 Submitting a Late Change Request

Changes to the schedule after the ATC load for a selected DAS has been generated, are submitted via a late change request for the specified DAS. This causes a new ATC load to be generated and the Ground Schedule to change to reflect schedule updates. If ATC loads have been generated for subsequent detailed activity schedules, they will be removed from the system. Subsequent DASs will need to be resubmitted for ATC load generation.

To submit a late change request:

1. Click **Late Change** on the Load Generator. The Load Generator Late Change window opens (see Figure 8.8.1.2-1).
2. Select **Master Plan**.
3. Enter the start time of the late change.
4. Select **DAS** from the Jobs Completed list.
5. Click **Submit**.

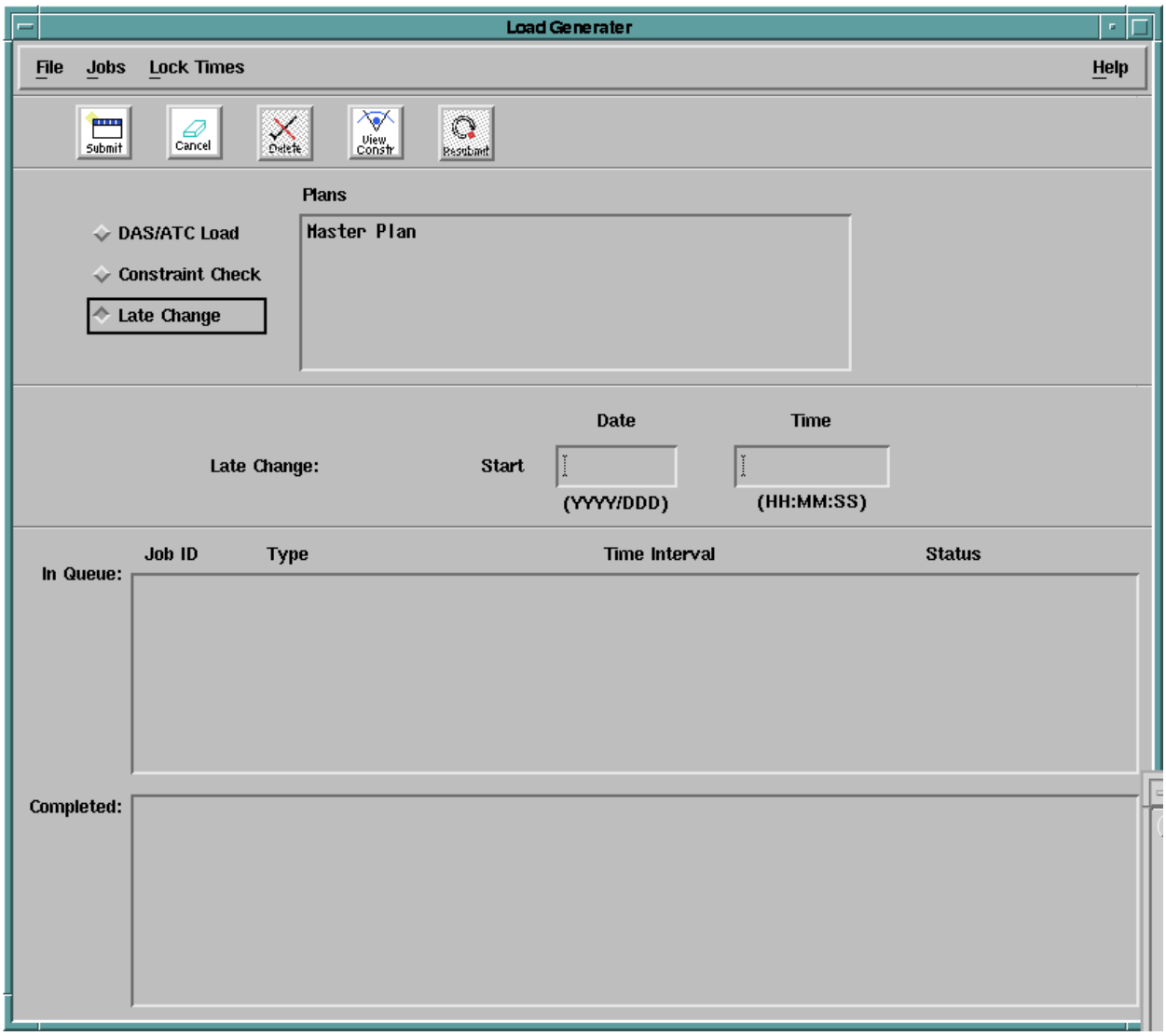


Figure 8.8.1.2-1. Load Generator Late Change Window

8.8.1.3 Checking for Constraints

The Load Generator can check for either Activity Level Constraints or Command Level Constraints. Activity constraints are conflicting instrument or spacecraft modes and activities. (Command constraints are constraints against single commands. Selecting command-level constraints will automatically force activity level constraints to be verified.) Activity Level Constraint Violations can also be viewed on the Timeline.

To submit a constraint check request:

1. Click **Constraint Check** on the Load Generator window. The Load Generator Constraint Check window opens (see Figure 8.8.1.3-1).

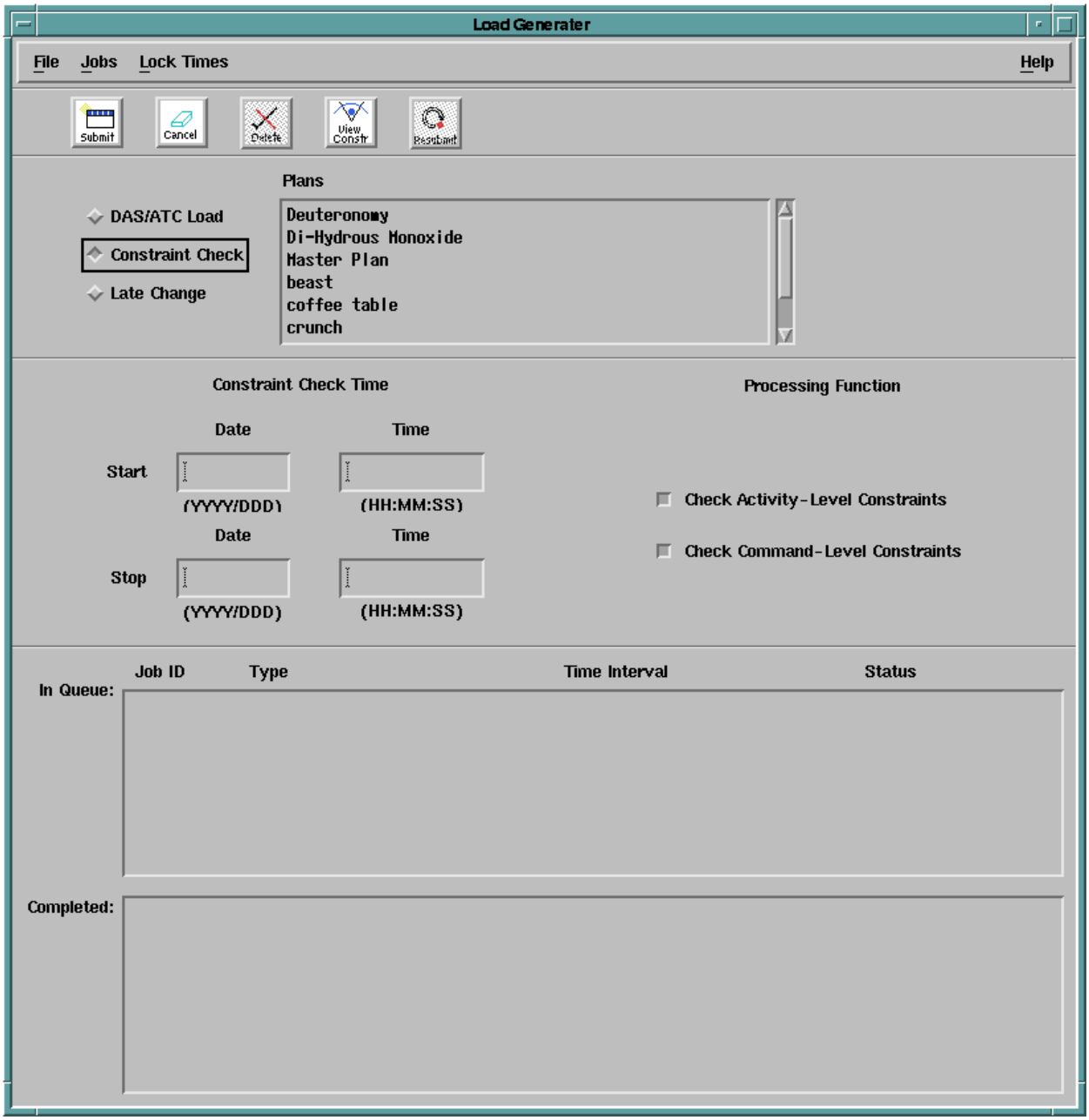


Figure 8.8.1.3-1. Load Generator Constraint Check Window

2. Select the desired plan.
3. Select “Activity-Level” and/or “Command-Level” constraints.
4. Enter the start and end times of the constraint check.
5. Click **Submit**.

8.8.1.4 View Results of Request

The Load Generator provides a dialog box to view constraint violations and a textual report (see Figure 8.8.1.4-1).

To view constraint violations:

1. Select an entry from the list of Pending Jobs or Jobs Completed on the Load Generator window.
2. Click **View Constraints** to open the Constraint View dialog box displaying constraints.
3. Click **Close** when you are done reviewing the constraints.

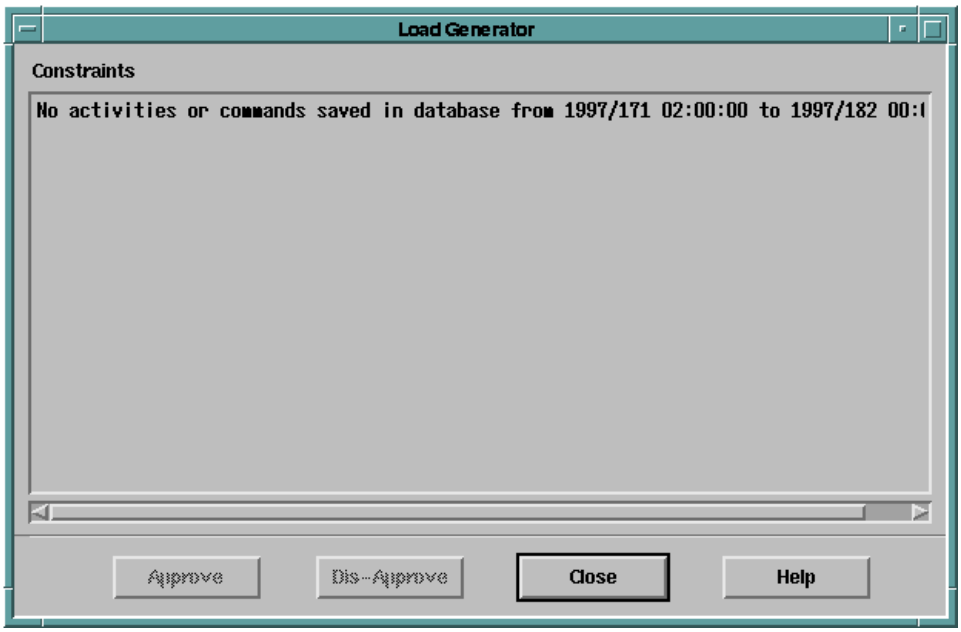


Figure 8.8.1.4-1. Constraint View Dialog Box

To generate a constraint report:

1. Select an entry from the list of Completed Jobs on the Load Generator window.
2. Select **Constraint Report** from the Jobs menu

8.8.1.5 Approve or Disapprove Soft Constraints

Soft constraints can be approved or disapproved by the FOT. If you approve the soft constraints an ATC load and ground schedule are generated. If you disapprove the soft constraints, the ATC load and ground schedule will not be generated.

To approve or disapprove constraint violations:

1. Select an entry from the list of Pending Jobs on the Load Generator window.
2. Click **View Constraints** to open the Constraint View dialog box displaying constraints.

The Approve or Disapprove Soft Constraints dialog box opens (see Figure 8.8.1.5-1).

3. Click either Approve or Disapprove.

The Approve or Disapprove Soft Constraints dialog box disappears.

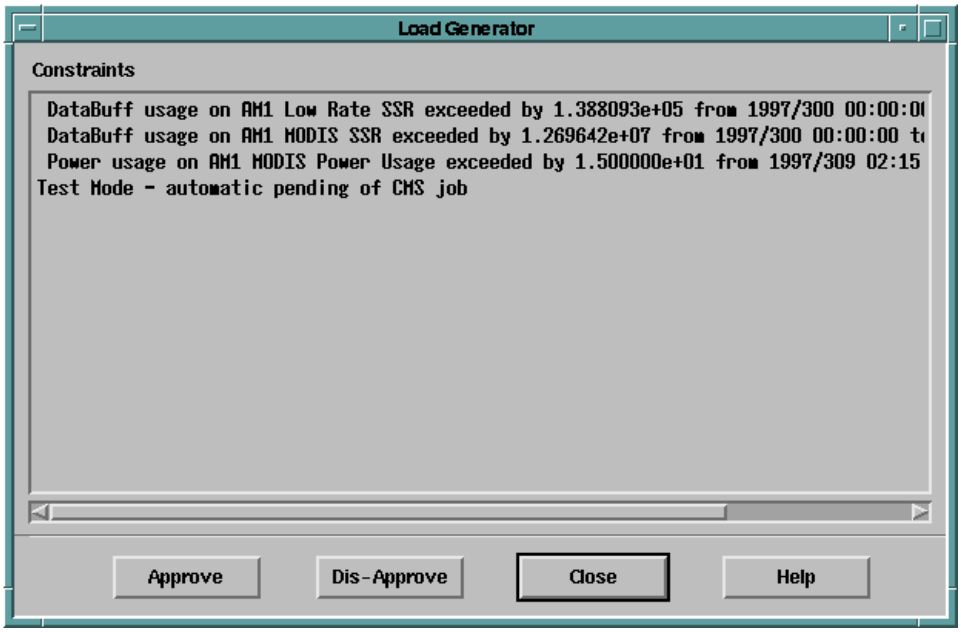


Figure 8.8.1.5-1. Approve or Disapprove Soft Constraints Dialog Box

8.8.1.6 Deleting a Request

A request (DAS, late change, or constraint check) can be deleted from the queue if it is NOT "Processing." Once a job is processing, it must be allowed to complete. Deleting a DAS request will cause any subsequent DAS requests to be deleted also, as DASs must be generated in order.

To delete a request:

1. Select the entry to delete from the queue lists on the Load Generator window.
2. Click **Delete** from the **Jobs** menu.

8.8.1.7 Resubmitting a Request

A failed request (DAS, late change, or constraint check) can be resubmitted from the queue. A new request is generated.

To resubmit a request:

1. Select the entry to resubmit from the completed queue list on the Load Generator window.
2. Click **Resubmit** from the **Jobs** menu.

8.8.1.8 Unlocking a Resource

When a DAS is requested, that portion of the Master Plan will be locked. In order to make changes to part of the Master Plan that has already been locked to accommodate a late change or to correct a constraint violation after a failed attempt to generate a DAS, you must first unlock the affected resource(s). Unlocking resources can only be done by designated members of the FOT. After a resource is unlocked, any authorized user may make changes to that resource during the unlocked period.

To unlock a resource:

1. Select **Show Locks** from the **Modify** menu. The Load Generator Locking and Unlocking Resources window opens (see Figure 8.8.1.8-1).
2. Scroll to the desired resource and select it using the left mouse button.
3. Enter the desired lock time.
4. Click **OK**.

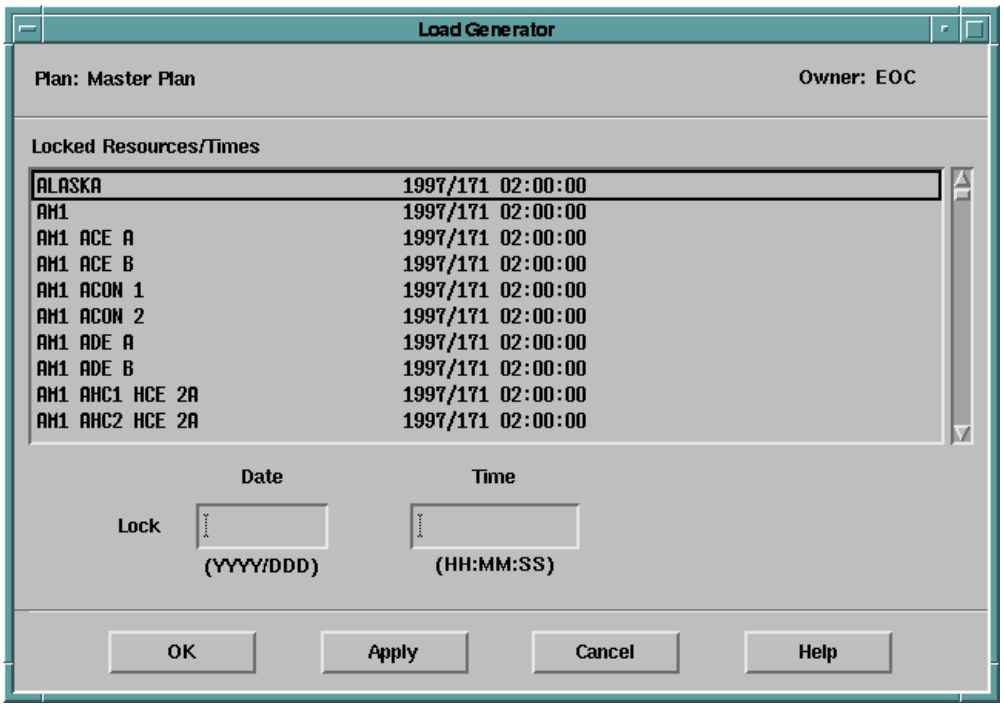


Figure 8.8.1.8-1. Locking and Unlocking Resources Window

8.8.2 Relative Time Command Sequence (RTS) Loads

The RTS Load Builder is used to ingest, generate, validate, schedule, and delete RTS loads for AM-1. The Builder is accessible via the Control window.

To access the RTS Load Builder

1. Select **Tools...** from the Control window.

   The Tools dialog box opens.

2. Select **RTS Load Builder** from the Tools dialog box.

   The RTS Load Builder opens (see Figure 8.8.2-1).

NOTE

To access the directive builder select the utility pull-down menu and select the **Directive Builder** (see section 6.2.5).

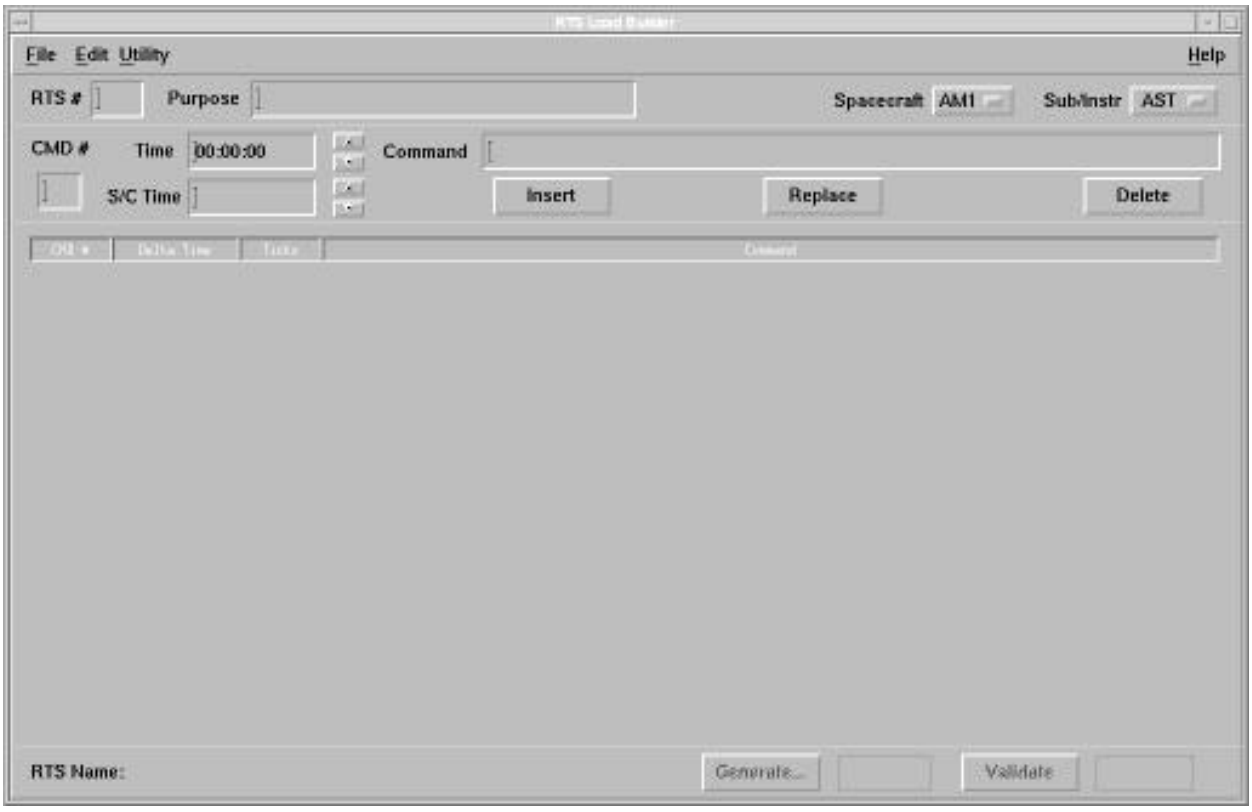


Figure 8.8.2-1. RTS Load Builder

8.8.2.1 Ingesting ASCII RTS Loads

ASCII RTS loads are ingested from SDVF. During the ingest, the ASCII representation is converted to and FOS internal format. Once formatted validation, generation, scheduling, and deletion may be performed.

To ingest an ASCII RTS load:

1. Select **Ingest** from the File menu.
2. Select a directory from the Ingest window and click **Filter.**
3. Select a file and click **Ok.**

8.8.2.2 Validating and Generating an RTS Load

RTS loads are generated using the RTS Load Builder. Before the load is generated, it will be constraint checked.

To submit a request to build an RTS load:

1. Select **New** from the RTS Load Builder's File menu.
2. In the RTS Load Builder window fill in: the RTS number, Spacecraft ID, Subsystem ID, the command number, and the execution offset. The command mnemonic and parameters for each command may be entered in the command text field once all commands for an RTS are entered manually or the directive builder may be used (see **NOTE** above).
3. Click **Validate** in the RTS Load Builder window. Any constraints produced by the validation will either appear in the Hard Constraints window (see Figure 8.8.2.2-1) or the Soft Constraints window (see Figure 8.8.2.2-2). Hard constraint conflicts are corrected by going back to the RTS Load Builder window and changing the commands associated with the conflicts and revalidating. Soft constraints can be overridden by clicking **Yes** at the prompt to generate load with constraint violations.
4. Once validation is completed, click **Generate** from the RTS Load Builder window to open the RTS Generator window (see Figure 8.8.2.2-3). Generating will automatically perform validation.
5. In the RTS Generator window, fill in the start time for the valid period, the stop time for the valid period, and the load initiate command (which is defined in the config file FmLdLoadInitConfig.cnfg) for the RTS load.
6. Click **OK**. A load generation request will be sent to CMS. Once the load has been built, a load generation report will be produced. The report can be accessed by the Report Browser Tool (see Section 7.13).

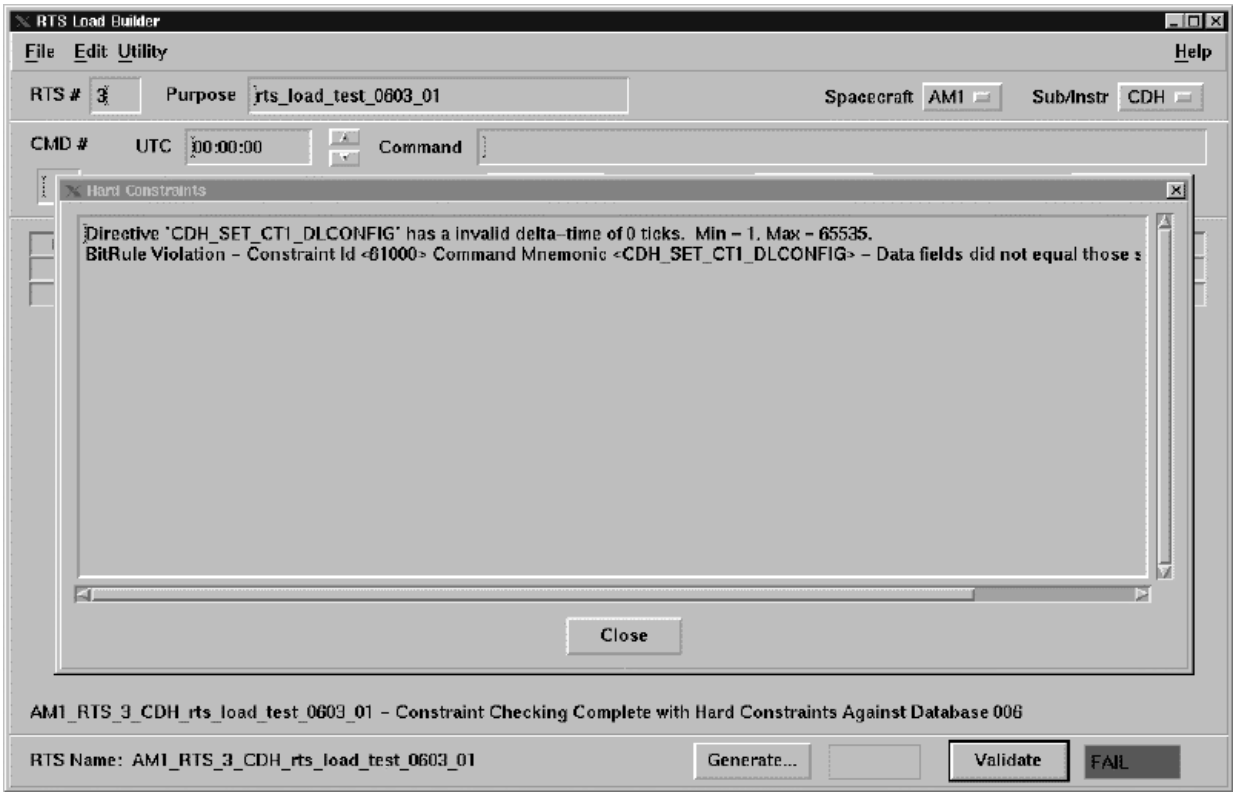


Figure 8.8.2.2-1. Hard Constraint Window

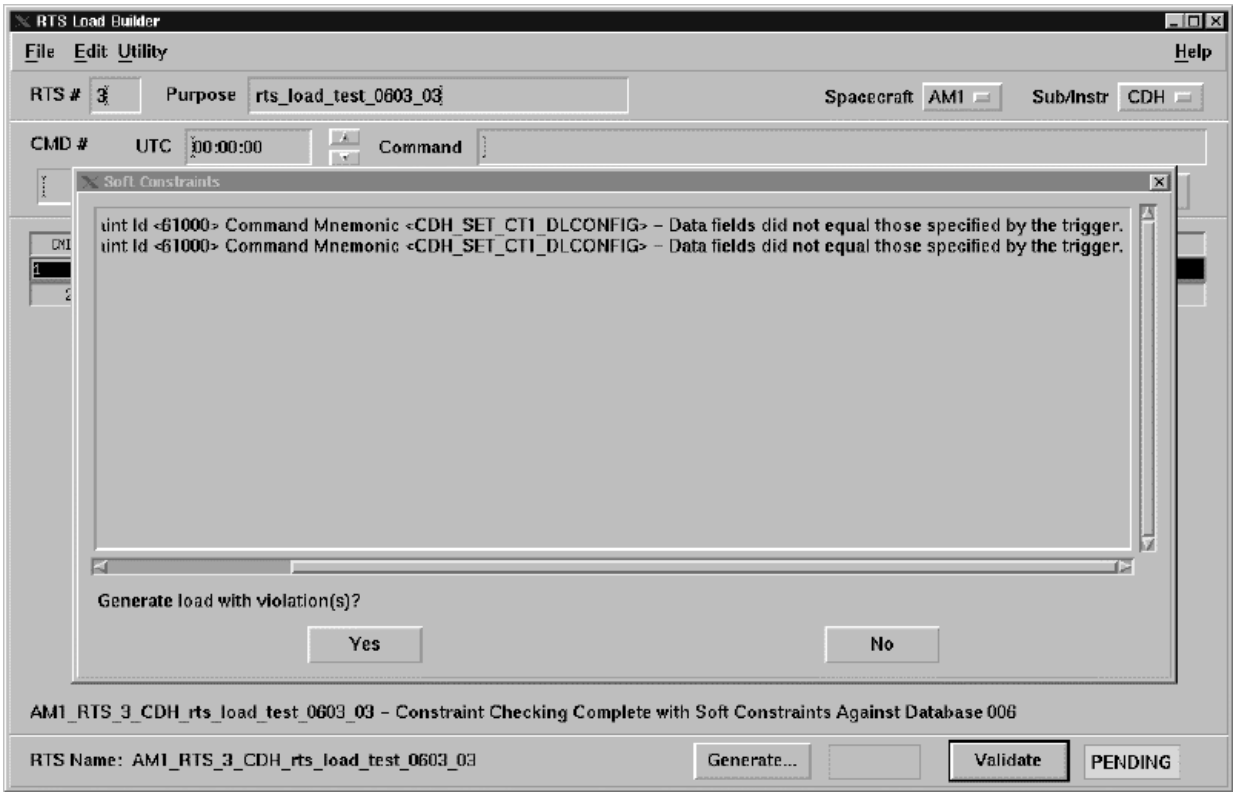


Figure 8.8.2.2-2. Soft Constraint Window

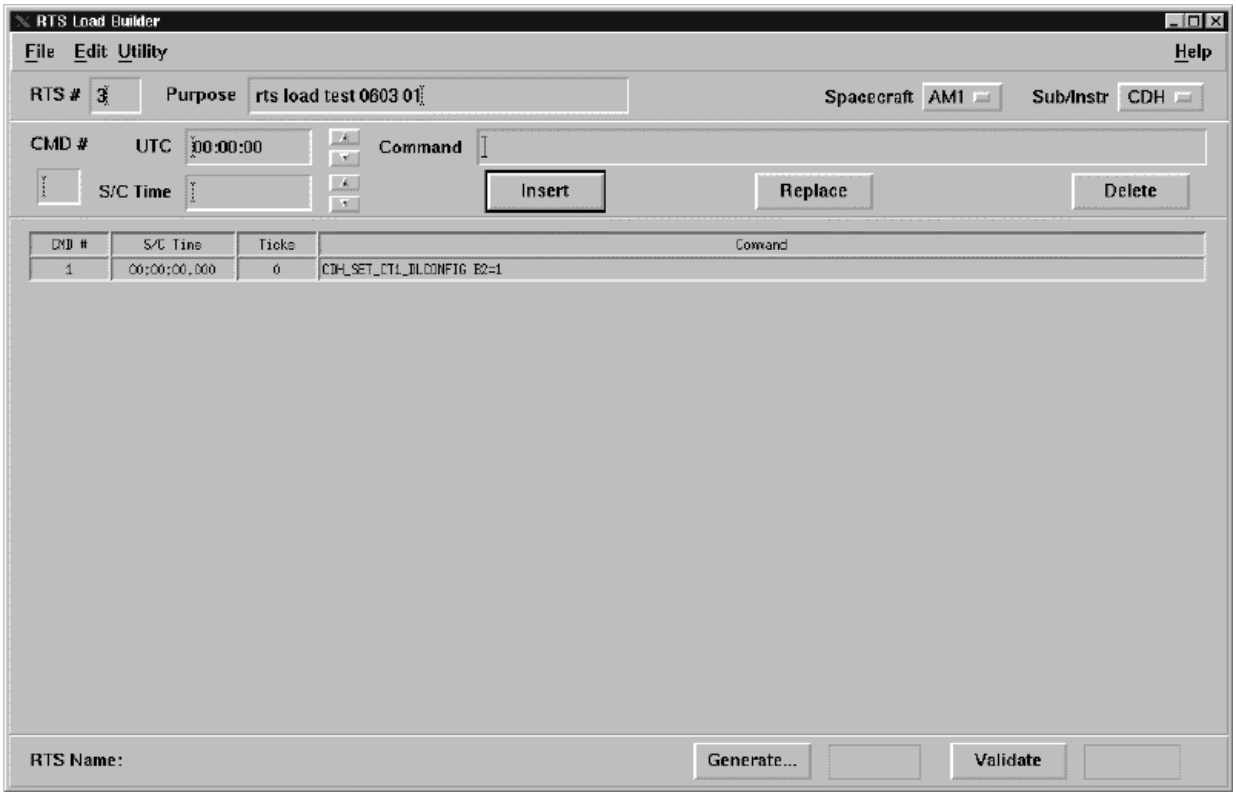


Figure 8.8.2.2-3. RTS Generator Window

8.8.2.3 Deleting an RTS Load

Deleting an RTS load is only permitted if the load has not already been uplinked. RTS loads are deleted through the RTS Load Builder.

To delete an RTS load:

1. Select **Delete** from the RTS Load Builder File menu. The RTS Load Delete window opens with a listing of loads (see Figure 8.8.2.3-1).
2. An RTS load may be deleted from either the ingest directory or the Load Catalog. Select the RTS load requested to be deleted.
3. Click **OK**. The deletion request will be sent to the Load Catalog. The Load Catalog will delete the load from the system if it has not already been uplinked.

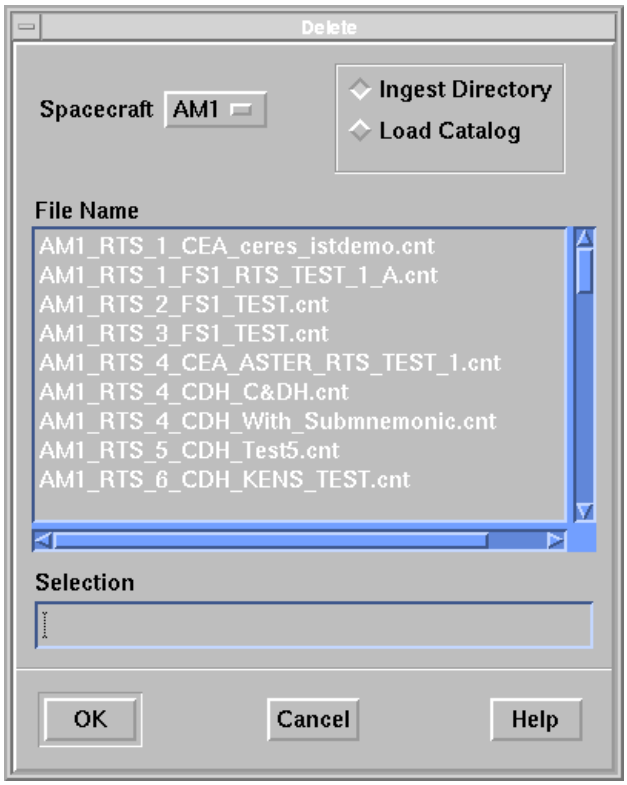


Figure 8.8.2.3-1. RTS Load Delete Window

8.8.2.4 Scheduling an RTS Load for Uplink

Once an RTS load has been generated, it can be scheduled for uplink at any time.

To schedule an RTS load for uplink:

1. Select the load that is to be uplinked from the RTS Load Builder.
2. Click **Schedule**. The Load Scheduler tool opens on the window. Refer to paragraph 8.2.5 for additional information on the Load Scheduler. The results of the scheduling are displayed in the Status Message portion of the RTS Load Builder window.

8.8.3 Table Loads

The Table Load Builder is used to generate, validate, schedule, and delete spacecraft table loads for AM1. But, unlike ASCII RTS load ingesting, ASCII table loads sent from SDVF are automatically converted, validated and generated. The process is similar to ingesting FDF table loads. The builder is accessible through the userstation's Control window.

To access the Table Load Builder:

1. Click **Tools...** on the Control window.

2. Select **Table Load Builder** from the Tools dialog box listing the available tools. The Table Load Builder window opens (see Figure 8.8.3-1)

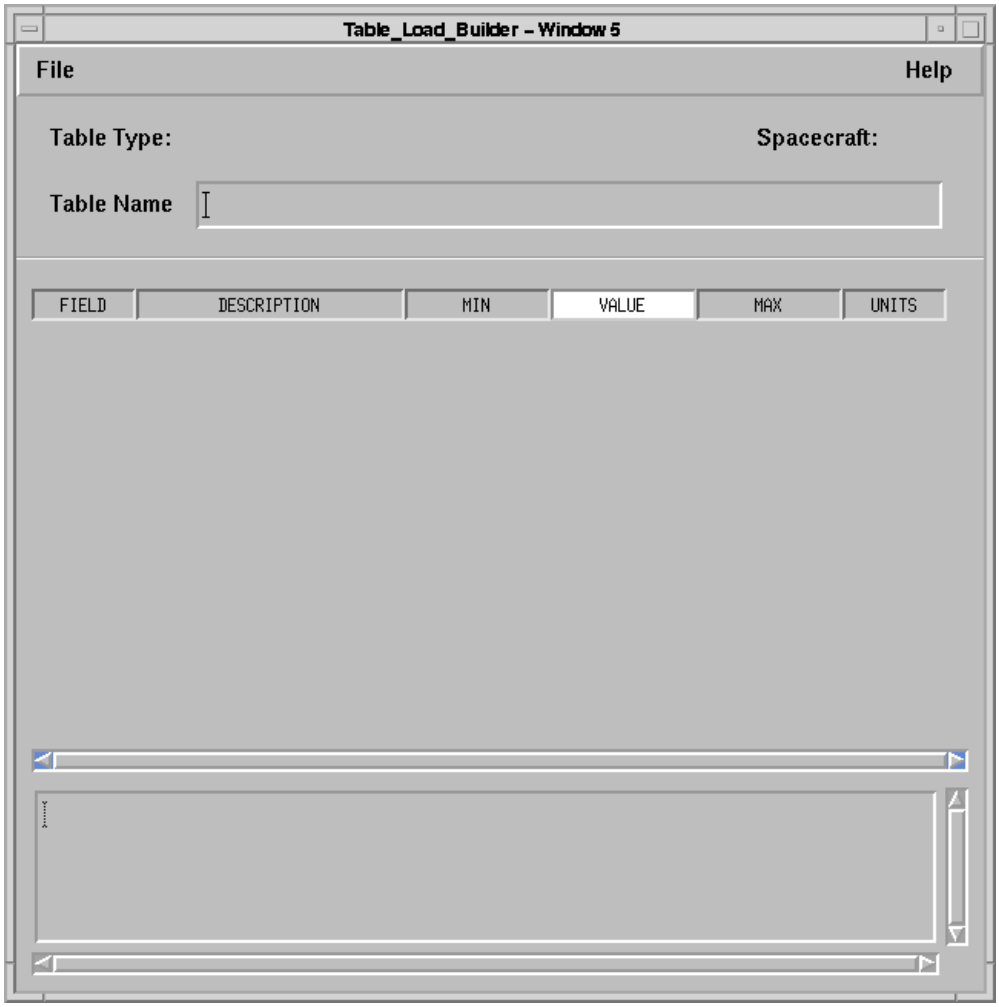


Figure 8.8.3-1. Table Load Builder Window

8.8.3.1 Generating a Table Load

A table load can be created from a dump, a previous load, or a template. All three of these options are accessible through the Table Load Builder's File menu option. Once loaded into the Table Load Builder, the generation process is the same.

To submit a request to build a table load:

1. Select **New** from the File menu in the Table Load Builder window. The Table Template window opens on the window.

2. Select the desired table template. The file definition window opens on the window. It will contain the information for each field in the table, these are set to the default values as defined in the database.

3. To update the table entry defaults, move the cursor to the value field and enter the desired value. Type <Return>. Repeat for all entries that need to be changed.

4. Click **Generate**. Each field entry will be validated, before a load is generated. Validation messages and load generation messages opens in the Status Message portion of the window.

8.8.3.2 Deleting a Table Load

Deleting a table load is only permitted if the load has not already been uplinked. Table loads are deleted through the Table Load Builder.

To delete a table load:

1. Select **Delete** from the Table Load Builder's File option. The Table Deletion window opens with a listing of loads (see Figure 8.8.3.2-1)..

2. Select the Table load to be deleted.

3. Click **OK**. The deletion request will be sent to the Load Catalog. The Load Catalog will delete the load from the system if it has not already been uplinked.

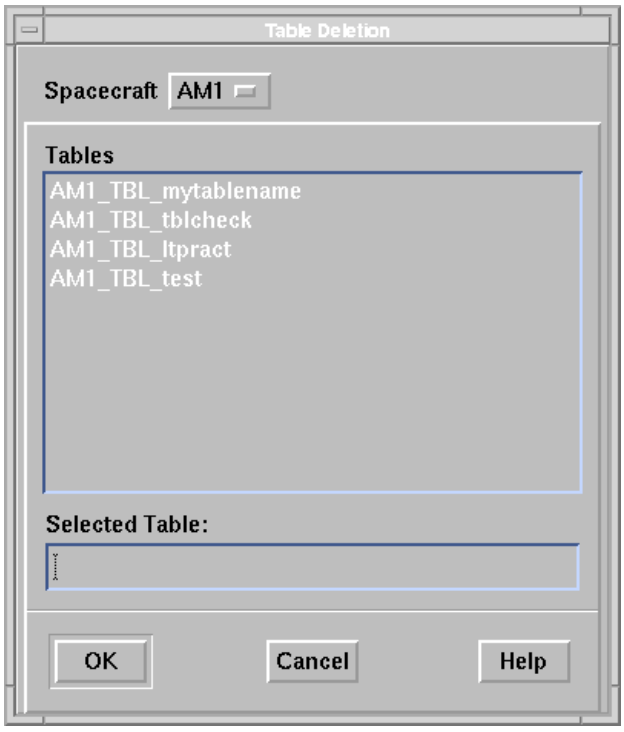


Figure 8.8.3.2-1. Table Deletion Window

8.8.3.3 Scheduling a Table Load for Uplink

Once a Table load has been generated, it can be scheduled for uplink at any time.

To schedule a Table load for uplink:

1. Select the load to be uplinked.
2. Click **Schedule**.

   The Load Scheduler tool opens. The results of the scheduling opens in the Status Message portion of the Table Load Builder window.

8.8.4 Microprocessor Loads

The Binary Load Builder is used to ingest, generate, schedule, and delete microprocessor loads for AM-1. The builder is accessible via the Control window.

To access the Binary Load Builder:

1. Click **Tools...** on the Control window.

   The Tools dialog box opens.

2. Select **Binary Load Builder** from the Tools dialog box.

   The Binary Load Builder window opens (see Figure 8.8.4-1).

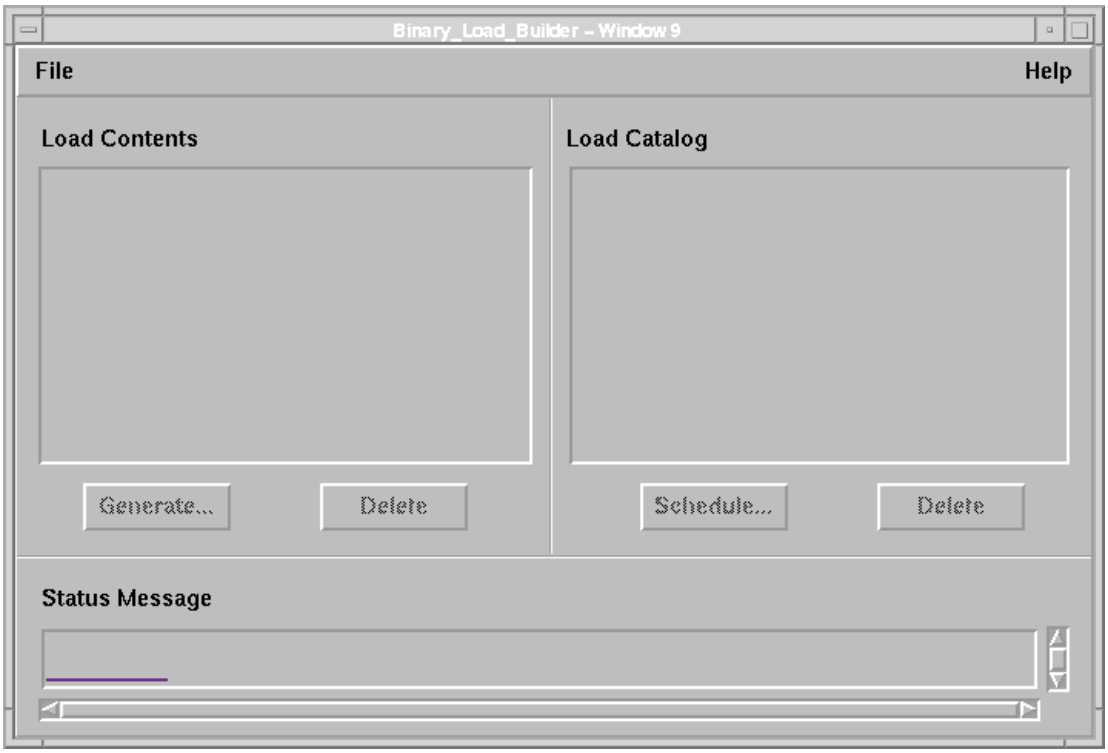


Figure 8.8.4-1. Binary Load Builder Window

8.8.4.1 Ingesting a Microprocessor Load

A binary load contents file must be ingested before a microprocessor load can be generated. To ingest a microprocessor load contents file, you must have already created and properly named the binary file.

To ingest a microprocessor load:

1. Select the Ingest option under the Binary Load Builder's File menu.

   A File selection box opens on the window.

2. Either enter the path and name for the file in the text box or click on the file name in the selection area.

3. Select **OK** on the File selection window.

   The selection window will disappear and the results of the ingest appear in the Status Message portion of the Binary Load Builder window.

8.8.4.2 Generating a Microprocessor & a Flight Software Load

When a load is generated, the load contents file is packetized and partitioned into appropriate sized loads. Each load partition will have the appropriate load initiate command. The load partitions will be saved to file and a load catalog entry will be created for the entire load.

To submit a request to generate a microprocessor load:

1. From the Load Contents side of the Binary Load Builder, select the load contents file that will be converted into a load.

2. Click **Generate**.

   The Generate Binary Load window opens (See Figure 8.8.4-1).

3. From the Generate Binary Load window click **Select Time**.

   The Time Selector dialog box opens.

4. On the Time Selector dialog box, enter the start and stop time for the load's valid period.

5. Click **OK** on Time Selector dialog box.

   The dialog box closes. The Valid Period portion of the Generate Binary Load window is updated.

6. Within the Generate Binary Load window, enter the start and stop location for the load; the terminal ID for the microprocessor or flight software; the load initiate command mnemonic and submnemonic parameters; and the description for the load.

7. Click **OK** on the Generate Binary Load window.

   A status message concerning the success or failure of the load generation appears in the Status Message portion of the Binary Load Builder window. The name of the

microprocessor or FSW load appears in the Load Catalog portion of the Binary Load Builder window.

8.8.4.3 Deleting a Microprocessor or FSW Load

Only loads that have not been uplinked can be deleted.

To delete a microprocessor load:

1. From the Load Catalog side of the Binary Load Builder, select the load to be deleted.
2. Click **Delete**.

   A confirmation dialog box opens on the window.
3. Click **Yes**.

   The results of the delete appears in the Status Message portion of the Binary Load Builder window.

8.8.4.4 Scheduling a Microprocessor or FSW Load for Uplink

Once a microprocessor load has been generated, it can be scheduled for uplink at any time.

To schedule a microprocessor load for uplink:

1. From the Load Catalog side of the Binary Load Builder, select the load to be scheduled.
2. Click **Schedule**.

   The Load Scheduler window opens on the window (see Figure 8.6.5-1). The results of the scheduling opens in the Status Message portion of the Binary Load Builder window.

8.9 Validating Database

Database validation processes are used to ensure data integrity in the databases. There are two validating processes: activity validation and constraint validation. Activity validation checks the activity against existing system defined commands. Constraint validation checks constraints against existing resources, activities, modes, or event types associated with the resources. The processes generate reports containing the data validation information.

8.9.1 Activity Database

The Activity Validating application (st_av) is a checking process used to validate each activity currently stored in an unvalidated database. Before promoting the unvalidated activities into operational activities, they have to undergo validation checking.

An activity is invalid if any resource, mode, event type, command, or command parameter does not exist.

After performing the checking process, a report file, avReport.out, will be generated. This file is in the same directory where the script, st_av, is located. The summarized numbers of valid and invalid activities will be described in the file.

To start the Activity validation:

Invocation of the Activity Validator is done via a script st_av found in the directory designated by the STARTUPFILELOC environment variable from the UNIX command line. Its usage is as follows:

cd $STARTUPFILELOC

st_av.

You can view the result, by editing the report file, avReport.out, by using the command:

vi avReport.out.

Example of report file:

++

There are 5 activities.

5 passed the validation checking, and

0 do not pass the validation checking.

++

8.9.2 Constraint Database

The constraint validator process (st_cv) is used to check every activity-level constraint in the database against the resources, activities, modes and events associated with the resources on which the constraint is imposed. A constraint is invalid if any resource, activity, mode, event type which the constraint references, does not exist. The report file generated by the process, lists the validation status of each constraint and the causes for the invalid constraints. This report file, "constrValidate.out", is written to the directory designated by the environment variable STARTUPFILELOC. The numbers of valid and invalid constraints are summarized at the end of the file.

To start the constraint validation:

Invocation of the Constraint Validator is done via a script st_cv found in the directory designated by the STARTUPFILELOC environment variable from the UNIX command line. Its usage is as follows:

cd $STARTUPFILELOC

st_cv.

You can view the result, by editing the report file, constrValidate.out, by using the command:

vi constrValidate.out.

Example of report file:

Constraint: constraint1 with ID: 1 is valid.

Constraint: constraint2 with ID: 2 is valid.

Constraint: constraint3 with ID: 3 is valid.

Constraint: constraint4 with ID: 4 is valid.

The right event type in constraint 5 is not found.

Constraint: constraint5 with ID: 5 is not valid.

++

There are 5 constraints.

4 passed the validation checking, and

1 do not pass the validation checking.

++

8.10 Planning and Scheduling Tips

The Planning and Scheduling system is very flexible, allowing you considerable freedom when using the system. This section contains recommendations on using the system in a productive manner. Each subsection includes things all users should be aware of. The system will not produce errors or warning messages if you do not follow the recommendations in this section and in some circumstances there may be good reasons for not following the hints. It is the responsibility of each instrument team and the FOT to determine how to use the Planning and Scheduling system. It is very important that each team decides the appropriate way to use this system and follow the approach consistently.

8.10.1 Naming Conventions

All activities, BAPs, constraints, and plans are visible to all instrument teams and the FOT. When defining these, you might want to prefix names with the three letter abbreviation for each instrument. Also, make sure that the names are unique across different instrument teams. For example, CERES Fore-Calibration is a much better name than just Calibration.

8.10.2 Defining Activities

An **activity** represents a request to change a resource's configuration. The activity may contain ATC commands that will be loaded into the ATC buffer; Real-Time commands that will be included in the ground script; ECL directives and procedures that will be included in the ground script; and mode transitions used within the Planning and Scheduling system for display and constraint checking.

A **resource** is an instrument, spacecraft subsystem, or instrument subsystem referenced during activity scheduling. Resources are displayed on the Timeline along the vertical axis. Activities are scheduled against a single resource; however, they may modify modes of other resources.

A **mode** characterizes a component's operational state by representing power consumption, data rate, and restrictions in operational sequencing. Modes consist of a mode name (used for Timeline display and constraint checking), power drawn in Watts, (used for spacecraft consumption modeling), and data rate (used for SSR Buffer Modeling.)

Commands and other Activity components (such as modes) may have negative offsets from the reference start time or positive offsets from the reference stop time. Using offsets outside the activity scheduling period allows you to have any activity setup/cleanup time taken into account. For example, if you had a calibration that required 5 minutes of warm-up before starting the calibration and 5 minutes of cool down before other activities could resume, you could define a calibration activity:

START -00:05:00 MODE WARM-UP

START +00:00:00 MODE CALIBRATION

STOP +00:00:00 MODE COOL_DOWN

STOP +00:05:00 MODE IDLE

If you want to perform the calibration for one hour, schedule the above activity from 13:00 to 14:00. The warm-up would start at 12:55, and the instrument would return to service at 14:05, with exactly one hour of calibration.

You can create activities to be scheduled on all scheduling resources, or schedule all activities on a parent resource and display modes on the child resources. If the child resources are independent of each other, you will have to use over subscription so that activities scheduled on one child will not over-write activities already scheduled on other child resources. For this reason only, we recommend scheduling against each affected resource.

Each activity should include commands that together perform a single logical function. To ease activity management, you should limit the number of activities defined in the system. Activities should be used to model internal stored sequences of ATC commands. A logical set of ATC commands starting an internal sequence that causes mode transitions can be modeled.

Avoid activities that perform two or more tasks because reusing the activity will be more difficult; constraints should be used for this.

It is usually better to define shorter activities. For example, it is better to define a “turn on” activity and a “turn off” activity, rather than an “is on” activity. The “is on” should be represented in the mode of the resource.

Remember that when you modify an activity it is saved with a version number one greater than the version that you started with. If you wish to have this new activity referenced in a BAP that you have already defined, you must modify the BAP to reference this new version of the activity; otherwise, scheduling the BAP will result in scheduling the older version of the activity.

When a DAS is generated, activities will never be split across loads. The start time of the activity is the determining factor of whether the commands in the activity are in one DAS or the next.

8.10.3 Defining BAPs

BAPs are very a powerful way for scheduling activities that have to occur repeatedly on a routine basis. When you define BAPs creatively, the daily scheduling tasks will become a lot easier. Do not put too many activities in one BAP. Define several BAPs with a small number of activities in them. And use the BAP install function to include the activities on the schedule.

8.10.4 Constraints

Remember that constraint checking is performed when an activity is scheduled. This means that if you happen to change a constraint definition and bring it to the operations area, the change will not be reflected on the Timeline for the activities that were already scheduled prior to the modification that you made to the constraint. All activities scheduled after such modification will be checked with respect to the new constraint.

8.10.5 Scheduling

Activities are scheduled on the timeline according to:

Start time by Absolute Time or Relative offset from an orbital event

Stop time by Absolute time, relative to an orbital event or with a fixed duration

You can choose to schedule the activity using any of the above methods; it makes no difference unless new orbital data arrives with different ephemeris. For example, new data might move a sunrise event 10 seconds later. If you would want your activity to move with the orbital data, schedule it relative to that event. If you want it to be fixed in time (for example, at 10AM every day), schedule it with an absolute time.

Over subscription allows you to schedule overlapping activities on the same resource. Over subscription can cause commands within different activities to be intermixed. The timeline tool displays activities with shorter durations on top of activities with longer durations There are times when viewing a schedule that you will be unable to tell that two activities are overlapping each other. It is better to schedule on individual resources. When scheduling with over subscription, you will not be notified if you schedule the same activity twice approximately the same time. You will not see the second activity visibly on the Timeline.

In addition, it is more likely that command level constraint violations will occur when using over subscription since individual activity definitions are command level constraint checked just prior to DAS generation.

With the exception of the SSR-buffer, there is no feedback from telemetry into the planning and scheduling system. In some cases it may be desirable (and necessary) to update the Master Schedule to reflect as-flown data. For example, if an activity was scheduled to put an instrument into a calibration mode, but due to an anomaly, the instrument did not go into that mode, it may be

desirable to remove the scheduled activity after the fact so that the spacecraft model maintained within the planning and scheduling system matches the actual state of the spacecraft.

8.10.6 Timeline

Each instrument team should use a standardized set of colors, especially for modes. Avoid using red or yellow for normal modes. These should be reserved for error and warning conditions.

You should save your plan frequently. If you are making substantial changes, you should make them to a what-if plan, but you should still save frequently. Saving a plan makes it visible to all instrument teams and the FOT. If you scheduled your activities on a What-if plan and are satisfied with the results, make sure you move them into the Master plan. Because only the Master plan is used to generate the DAS.

8.10.7 Aster Filter

The ASTER filter is designed so new schedules will overwrite all previously scheduled activities during the time period specified in the header file.

8.10.8 BAPs

It is recommended that you use only one BAP on any single resource at a given time. More than one might cause some activities to not be scheduled. Do not install more than one BAP on a resource.

8.10.9 Recycler

When an activity is cut from the timeline, it is placed into two places: The activity Recycler and the timeline's own paste buffer. If you go into the Recycler and delete the activity from there, it will be removed from the Timeline's paste buffer also, preventing you from pasting it back onto a plan.

8.10.10 Event Handler

Many Planning and scheduling processes print diagnostic messages to the event handler. Use the event handler to monitor your own operations activities and those of others such as instrument teams. If this tool is iconified or displayed behind other tools, important messages may not been seen.

8.10.11 Load Generator/Queuer

The FOT and instrument teams should run the activity and command level constraint checks as soon as their plan for a given day stabilizes. Do not count on the timeline as your only source of constraint information, as many activities are very small and may be difficult to see (especially if over subscription is being used).

8.10.12 FDF Data

The schedule adjuster is very computer intensive and can cause every BAP and every activity scheduled relative to an event to be rescheduled. It is best to run this during off hours with consideration for the local time differences among instrument sites.

After new FDF data has been ingested into the system and all the events are updated, the event generator should be run to add the additional computed events into the system.

There should be a set schedule for running the schedule adjuster and event generator. All ISTs should be notified when this processing will take place.